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ANNALS of SURGERY

A Monthly Review of Surgical Science and Practice

Edited by

LEWIS STEPHEN PILCHER, M.D., LL.D.
of New York

With the Collaboration of

SIR WILLIAM MACEWEN, M.D., LL.D. of Glasgow

SIR W. WATSON CHEYNE, C.B., F.R.S. of London

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ANNALS *of* SURGERY

VOL. LXVI SEPTEMBER, 1917 NO. 3

CONSERVATISM IN SURGERY

THE PRESIDENTIAL ADDRESS DELIVERED BEFORE THE AMERICAN SURGICAL ASSOCIATION, BOSTON, MASS., MAY 31, 1917

BY SAMUEL J. MIXTER, M.D.
OF BOSTON

FELLOWS OF THE AMERICAN SURGICAL ASSOCIATION:

You have honored me by choosing me to be your President, the highest honor that can come to an American surgeon. My appreciation of that honor is all the greater because it is more than I deserve for work accomplished, and is a mark of your affection and esteem, of your feeling that I have at least tried to "do my bit" in bringing American surgery to the position it occupies to-day. Gentlemen, I thank you with all my heart.

In these days of war and peril, of struggle of Right against Wrong, of awful waste of human happiness and human life, when we are just preparing to fight for our lives and all that is near and dear to us and humanity, the medical profession must do its part.

A year ago our President, Dr. Le Conte, urged upon us and the country the necessity of medical preparedness, but how little of the necessary work has yet been done. The army needs, and must have, young, hospital-trained medical men to care for the troops to be used in this country and abroad, and these men must have special training for their work if they are to serve efficiently. It is our duty as older men to aid in this movement. Let each one of us try to do his part in securing enlistments either to the Medical Corps of the Army, or to the Medical Department of the Officers' Reserve Corps.

All honor to those members of our Association and other medical bodies who are now working at home or abroad, helping to throttle the rabid beast of the world, the bite of whose poisoned fangs can only be cured by one antitoxin. Now, if never before, we strive for Peace with Victory. Some are now "Somewhere in France," more are going with hundreds of younger men to work for those of us who are forced to stay behind, facing dangers that we cannot share.

The death rate in the Medical Corps has always been high, but it is bound to be higher; for it has remained to be the crowning shame of Ruthlessness and Germany that a supposed civilized nation refuses to recognize the cross on the arm or on the side of a hospital ship, sending wounded men and Red Cross nurses to the same death to which they sent that splendid

woman, our friend and companion, Marie Depage. The greater the danger, the greater the honor, and we know that our doctors and our nurses will not be found wanting, but ready to face danger whenever and however it comes, whether from disease, shot and shell, or the viper of the sea.

What has all this to do with "Conservatism," which is the theme of this paper! Much—everything. War is the highest type of conservatism when it is waged in the defense of our homes and the rights of humanity. Nations, like surgeons, must resort to steel to accomplish their beneficent purposes, and the one who uses it hesitatingly or inefficiently through inadequate training or cowardice spreads broadcast the germs of physical or moral disease.

War being a fact, and not a theory, each one of us must ask what he can do to help toward a speedy and successful end. What can those of us do who are debarred by age, physical disabilities, or other reasons from taking the active part that we might wish? The absence of so many of the younger and more active men will throw on us services that we thought we had finished in hospital and private practice. The sick must be cared for, the young so treated that they grow up strong and lusty to take their part when the time comes, and the possible mothers so strengthened that they may bear healthy children to supply the place of those brave men and women who will be lost to the nation. There will be hard work and plenty of it for us all.

One very important subject for careful thought and action is the prevention of venereal disease, the curse of armies and navies the world over, but especially to be feared when young soldiers are brought together in mobilization and training camps, as shown in the present war and our late experience on the Mexican border. Every effort should be made to guard our men so that they may be kept well and efficient and return home clean and healthy. Shot, shell, and exposure are not the only means by which an army may be weakened. In this connection I feel that it is highly important for our Association to take some formal action urging the abrogation of the patents on salvarsan, a remedy at present practically unobtainable, though absolutely necessary for the present and future treatment of syphilis.

At a time like this, what more fitting topic of thought can we have than Conservatism—when everything tends toward exaggeration.

New problems are facing the surgeon in civil as well as in military life, as they always have and always will—and our old foes, sepsis, tuberculosis, and malignant disease still claim their victims in peace as well as in war. We are fighting them hard, but we must fight them still harder if we expect to win. Popular education in the early recognition of suspicious symptoms, laboratory and bedside study, early, thorough, and judicious operation, are to-day the best weapons we possess, and let us use them to the best of our ability.

Advances in Surgery are made slowly, step by step, through careful observation, experiment, and skilful manipulation—seldom by isolated bril-

liant dashes. It was my privilege to see the first, in fact, the first sixteen litholapaxies of Bigelow. Even the first operation was brilliantly successful, and the onlooker could hardly believe that it was the first, everything went so smoothly and successfully. It was only after looking over all the discarded apparatus, the great number of anatomical preparations and experiments, that one could understand the reason for the success. That first operation was the result of months and years of hard mental and manual labor. No matter how brilliant the idea, if crudely and carelessly carried out, it cannot be expected to bring success. I have always looked upon the preliminary work of Bigelow in perfecting his operation as one of the greatest lessons of my life, and it is to be regretted that the whole collection of broken, twisted, and discarded steel, rubber, and glass, the plaster casts of the bladder, with the various instruments in place, could not have been preserved and their history written for the benefit of those who would try short cuts in surgery.

In the program for this meeting there are papers on the treatment of intestinal stasis; in fact, the subject comes up at nearly every large surgical meeting, a sure sign that perfect success has not been attained. Because the intestine could be removed or sidetracked and the patient still live, men, having seen or heard of certain cases—successful or early reported as such, whether they were possessed of the necessary surgical skill and judgment or not, began to try all sorts of mechanical tricks with the offending organ, with the net result of a few cures and many failures. Do not understand me as condemning such operations in toto, for in suitable cases a properly selected surgical proceeding may be useful or necessary, but let it be carefully thought out and carefully executed. Few of us are guiltless of mistakes in this field of work. We have followed too blindly and enthusiastically in the footsteps of the first explorers, have worked by rule of thumb, instead of being thoughtful and caretaking.

Working by any fixed set of rules is sure to be followed by disaster. There is practically no surgical rule that should not occasionally be broken. It is better to open the trachea with a dirty knife and unclean fingers, than have a person choke to death; it is better to leave an occasional septic appendix or gall-bladder to drain, even if we believe in their routine removal —and this is where that something called "surgical judgment" comes in. Many a brilliant operator is a poor surgeon. A man should never let his deft fingers tempt him to useless or unnecessary work. This is so often done in the treatment of advanced malignant disease, and the result is either the death of the patient—which is not to be so much regretted perhaps—or he is left after unnecessary pain, both mental and physical, in a worse state than before. Fortunately, we have X-rays and radium to suggest, as they may relieve the pain and other symptoms in certain cases, even if they do not cure, and there is plenty of morphine in the world that may be used judiciously and freely toward the last. Too often an operation is done because the patient insists, and against the better judgment of the surgeon.

The result of the discovery of the curative value of the X-rays and radium is a good example of the danger of a non-conservative use of a valuable remedial agent. They were hailed as cure-alls in the treatment of malignant disease, and we all knew of cases of even beginning cancer of the breast that were X-rayed to death, when a thorough operation would probably have saved the patients. Misdirected enthusiasm ran wild, and I can to-day repeat that statement that I have made before, that, so far as they were used for the cure of malignant disease, more lives were lost than would have been the case had X-rays never been discovered. Let us hope that this statement may not be made of radium and of serum therapy. How often has a new remedy or method of great value in itself been discovered and published to the world, and then, when adopted by would-be followers or imitators, the result has been disaster to patients and the discredit of the method.

Within our own time what a long list of misused surgical and remedial methods could be compiled. Normal ovariotomy, so called, unsexed thousands of women for whose relief from every known ill from dysmenorrhœa to epilepsy was sought, and to-day the appendix is removed for the relief of symptoms due to trouble in some other organ which, from lack of knowledge or due care, has been overlooked. There are bound to be in every profession men who are careless, untrained, overenthusiastic, and rash.

The " near-surgeon," to use a favorite term of one of our members, is a dangerous man, and by example, precept, and teaching he must be raised to a higher level. All men have not the same minds, hands, or hearts, and even the best can always learn and advance if they will, for there is no such thing as standing still. With the broadening of the surgical field many more surgeons are needed than in the past, and all young men cannot have what we may call an ideal training, but must work ahead as best they may amid unfavorable surroundings, mental and physical. Some of these men become better surgeons than those who have had every advantage, for some men never become real surgeons, no matter how many operations they may do. The question of the incompetent or conscienceless surgeon is one of most vital interest to-day and one whose solution it will be hardest to find.

Conservatism in surgery means the best use in our power of the means at hand for the saving of life, the relief of pain and deformity, without unnecessary mutilation. The man who is timid, the man who is rash are alike far from being conservative—amputation when necessary to save life may be the highest form of conservation, and, if it is best to amputate at or above the knee for gangrene, the foot alone should not be taken off because the shock is less and the immediate mortality lower.

Timidity in the treatment of malignant disease is a common fault, the highest type of cowardice. True conservatism means going to the " anatomical jumping-off place," for no death is more to be dreaded than that from recurrence. Above all, is he a knave as well as a coward who refuses to operate on a desperate case, when life may perhaps be saved, for the

sake of his "statistics"—statistics which have morally damned many an otherwise good surgeon, had better be juggled in some other way or even lied about. The true surgeon is never "fearless." He fears for his patients, he fears for his shortcomings, his own mistakes, but never fears for himself or his professional reputation. His fear makes him a better man.

In the course of a somewhat busy professional life I have found my standard of the true surgeon growing ever higher and higher, and, even to a body of picked men such as this, it is not out of place to speak of the ideal, for who among us has attained or ever will attain the goal toward which he strives? Were it not for the unattainable the world would indeed be a poor place. Those qualities that make the true man in any walk of life are doubly necessary to the making of the Real Surgeon.

> Self-reverence, self-knowledge, self-control,
> These three alone lead life to sovereign power,
> Yet not for power (power of herself
> Would come uncalled for), but to live by law
> Acting the law we live by without fear;
> And, because right is right, to follow right
> Were wisdom in the scorn of consequence.

The present meeting of the Association promises to be small, numerically, so many of our members having already gone to the front or are soon to go. We have lost our secretary, our treasurer, and many others who are working for us and ours. What better men could we have to represent us and our country, knowing as we do that they are good men and true, real Surgeons, ready to do their part and more, for the Right. We hope and trust that we may all be together at future meetings in happier and more peaceful years—those already back from the front, those now at their posts, those still to go, and those who are left at home. Our next meeting may be smaller yet, so let us train ourselves and the younger men that the line across the sea shall never be broken until we have "Peace with Victory."

THE CARREL METHOD OF TREATING WOUNDS*

By Charles Langdon Gibson, M.D.

of New York

surgeon to the first (cornell) surgical division of the new york hospital

The great value of the Carrel method was impressed on me last year when I visited Carrel at his hospital in Compiegne and subsequently saw it carried out in the Allies' Franco-British Hospital at Annel in charge of Dr. H. H. M. Lyle, Surgeon to St. Luke's Hospital, New York City, and at La Panne, Belgium, at the Ambulance of our esteemed honorary member, Professor Depage of Brussels. I have put the method into practice in my service at the New York Hospital in the past seven months, aided by a nurse who was trained by Dr. Carrel and by an interne who was given special opportunities by Professor Depage to familiarize himself with the details of the method.

It is believed improbable that many institutions are properly equipped to take full advantage of the value of the method, as it is absolutely necessary to know thoroughly both the theory and the practical application of all the details. Dr. Lyle was situated only four miles away from Carrel and had frequent opportunities to familiarize himself with the practice of Carrel's hospital. Professor Depage sent some of his assistants and nurses to work with Carrel and also spent some time there himself.

The Carrel method of combating infection can be described as a series of steps which may be divided into three phases.

1. The proper treatment of a wound (*a*) to put it into the best possible position to heal secundum artem and (*b*) to adapt it to the employment of a suitable antiseptic.

2. The use of an antiseptic which will destroy the bacteria and neutralize the toxins without injuring the tissues or diminishing the normal process of repair. The antiseptic which has been found to conform to these requirements is the Dakin's solution of sodium hypochlorite.

3. The conversion of open wounds when sterilized by the above means into wounds which can and do heal in a manner similar to ordinary operative incisions after proper preparation and suture.

The popular conception of the Carrel method is the employment of a solution of sodium hypochlorite which generally will not conform to the requirements of the Dakin solution and applying it to wounds indiscriminately with little and generally no knowledge of the factors necessary to success or the drawbacks or dangers.

If the Carrel method is put into practice imperfectly poor results must

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* Read before the American Surgical Association, June 1, 1917.

follow and the method will fall into disrepute and its great value become lamentably obscured. While there is nothing mysterious or difficult in the method it does require intelligent application of each and every detail which its author worked out step by step and for which he has a definite reason backed by scientific investigation.

The importance of this meticulous care was demonstrated when the principal operator of Carrel's Hospital was detached and replaced by a surgeon equally experienced and competent, but unfamiliar with the method. Notwithstanding the continuity of the rest of the personnel Carrel told me that it took about a month for the later arrival to become familiar with the factors necessary to complete success.

The practical applications of the Carrel method have been well described in the article by Dr. H. H. M. Lyle in the Journal of the American Medical Association, January 13, 1917, and Dr. William O'Neill Sherman, in Surgery, Gynecology, and Obstetrics, March, 1917, which I recommend strongly to the attention of all those interested in the subject.[1] I shall, therefore, more particularly take up some of the theories on which the method was worked out. These are lucidly explained in the recent book of Carrel and Dehelly, "Le Traitement des Plaies Infectées," and I will give an epitomized translation of the principles as outlined by them in the following pages.

The choice of a substance best fitted to sterilize an infected wound depends in addition to its germicidal qualities upon the numerous other factors such as its irritating character, toxic power, solubility, capacity for penetration of the tissues, its absorption by the tissues, and its reaction with the proteins and other constituents of the tissues. The destruction of the bacteria by chemical action is due partly to the action of the antiseptic and partly to the changes it produces on the proteins or other substances making up these bacteria. Microbes in an aqueous solution are easily destroyed by antiseptics, as the mixture contains no other proteins. Microbes which are found in blood serum, pus, or other exudates are harder to destroy, as the antiseptic acts not only on the microbes but also on the proteid matter contained in such media. Therefore, the germicidal action of an antiseptic must be tested under the last described conditions and not simply in an aqueous solution. The germicidal activity of all the known antiseptics is much diminished by the presence of blood, serum, or similar substances. In such conditions this diminution is so great that the substances employed become inert. After comparing the numerous agents with regard to bactericidal action and possible irritation of normal tissues, Dakin favors neutral hypochlorite of soda and also chloralmines.

[1] "Disinfection of War Wounds by the Carrel Method," by Dr. H. H. M. Lyle, of New York, Journal of the A. M. A., January 13, 1917.

"Carrel Method of Wound Sterilization; Its Use in Military, Industrial, and Civil Practice," by William O'Neil Sherman, of Pittsburgh, Surgery, Gynecology, and Obstetrics, March, 1917.

A.—Dakin's Hypochlorite of Soda.—The antiseptic properties of sodium hypochlorite have long been known. It cannot, however, be utilized in wound sterilization in the form of Javel water or Labarraque solution, as these are irritating and may seriously damage the tissues. Dakin, therefore, sought to diminish this irritating action of sodium hypochlorite without modifying its antiseptic action. (The reader is referred for details to Dakin's article in the British Medical Journal, 1915. It may be stated that the modification consists in the neutralization of the free alkali which when present has caustic properties.)

B.—Bactericidal Action of Dakin's Solution.—The results of experiments in vitro are of little significance, as the conditions differ so greatly from the practical use. In wounds a small amount of pus is in contact with a large amount of the antiseptic and the hypochlorite solution is frequently renewed. In the laboratory tests the action of the hypochlorite on the microbes suspended in the pus is of short duration. If at the end of two or three hours one tests the amount of hypochlorite obtained in the mixture one finds sometimes a complete disappearance of the hypochlorite, as it rapidly combines with the proteins of the pus and cannot be recovered as such. Because of this rapid disappearance of the Dakin solution when mixed with wound secretion it must be instilled into wounds either continuously or, if intermittently, frequently. This ignorance of the chemical characteristics of the hypochlorites has led some surgeons to manifest astonishment, because a mixture of pus and hypochlorites after some hours incubation makes a medium in which bacteria grow readily. It is self-evident that these mixtures after such treatment no longer contain hypochlorite.

The bactericidal action of the Dakin solution has been studied in infected wounds. If it is applied to a wound so that its concentration is constant and its application is prolonged the microbes disappear. This fact has been amply demonstrated. It is wise, however, to determine if the treatment is the principal cause of the sterilization and if this sterilization is due to the sodium hypochlorite.

(*a*) It might be inferred that in these cases wounds become spontaneously sterile. In reality, this occurrence is improbable, as one never sees a series of infected wounds become sterile in a few days, but this hypothesis was worked out experimentally. In one corner of a wound, all parts of which were uniformly infected, there was placed a piece of filter paper kept constantly wet with hypochlorite. A piece of similar size was put over another portion of the wound and the whole wound covered by a protective dressing. After twenty-four hours the granulations under the hypochlorite paper were smooth and red and the bacteria had entirely disappeared. Under the other paper the granulations were irregular and pale and the bacteria were undiminished. In the rest of the wound not covered by these two filter papers the quantity of the bacteria was unchanged.

In a wound, half of it dressed with hypochlorite, the other with vase-

line, total disappearance of the bacteria was obtained on the hypochlorite half, with persistence of the infection in the other.

Similar results were obtained in deep wounds. Two shell fragments were lodged in two continuous wounds in the lumbar region. Both fragments were removed at one sitting. One wound was treated by intermittent instillation of the hypochlorite, the other by an ordinary dressing. The first wound remained painless and the bacteria disappeared completely from the smears obtained from the wound. The other became painful, was surrounded by a red areola and developed a streptococcus infection. In perforating wounds it was frequently noted that the region where the hypochlorite was instilled was sterile, while at the other end where the hypochlorite did not penetrate there were numerous bacteria. Numerous similar observations demonstrated convincingly the relation of cause and effect between the treatment employed and the results obtained.

(*b*) It may be asked next if the result is due to the antiseptic action of the hypochlorite or to the mechanical action of the instillation of the liquid. The following experiments were made as bearing on this point: A patient had on his thigh two wounds of approximately the same dimensions and of a similar bacterial content. One wound (No. 1) was treated with the hypochlorite solution, the other (No. 2) with physiological salt solution. At the end of twenty-four hours No. 1 showed not a single microbe to a field, while in No. 2 there were more than thirty to a field.

Similar experiments were made on superficial wounds on which were placed squares of filter paper of the same size. At the end of twenty-four hours the area covered by the filter paper wet with hypochlorite contained no microbes; that treated with saline contained many. (Experiments of treating infected wounds alternately with hypochlorite and saline gave convincing proof of the beneficial action of the hypochlorite.)

C.—Action of the Hypochlorite on the Microbic Toxins. — Several c.c. of pus were obtained from a grave case of tetanus and divided into halves. To the first was added two parts of hypochlorite solution 1/100, to the second an equal amount of .8 salt solution. At the end of an hour 1 c.c. of each of these mixtures was injected into guinea-pigs. The guinea-pigs injected with the salt solution died of tetanus in eight to ten days, the others who had been injected with the pus treated by hypochlorite presented no signs of tetanus and survived.

Similar experiments with filtrations were made with the same results.

D.—Toxic Action of the Dakin's Solution.—Sodium hypochlorite has very little toxic properties when introduced on the surface of wounds or into the subcutaneous cellular tissue of animals. It is dangerous if introduced into the circulation. It is strongly hæmolytic. It should not be injected into a vein or injected under pressure in deep wounds lest it be absorbed by the tissues.

E.—Action of the Hypochlorites on the Tissues.—If the Dakin solution is applied to a wound surface for several days, and occasionally for several

weeks, it will not usually cause any marked irritation. The action of the hypochlorite on the tissues is, however, much more marked in vitro than in vivo. In the wound non-vascularized tissues become dissolved and the surface rapidly becomes clean. If the integrity of a blood-vessel wall is affected the slough comes away quicker than in the usual wound healing. In the same way clots plugging vascular wounds may become dissolved by the action of the hypochlorite. It is, therefore, important to investigate carefully the conditions of vessels in the wound and make a particularly careful hæmostasis.

F.—Mode of Action of Hypochlorites.—Dakin attributes the germicidal action to a chemical reaction similar to what occurs with ammonia and hypochlorite.

In the sterilization of a wound the antiseptic performs the same function as does the scalpel in an operation. It is, therefore, only an instrument and does not constitute a method. The choice of a good instrument is essential to success. The chloralmines and the hypochlorites of Dakin are admirable instruments.

As Dakin's hypochlorite possesses the advantage of being strongly bactericidal and irritates the tissues very little, and at the same time is easily and cheaply obtainable, it would seem to be the antiseptic of choice during this war.

THE CONTACT OF THE ANTISEPTIC AND THE MICROÖRGANISMS

The antiseptic solution, sterilizing only what it touches, must come in intimate contact with the organisms infecting the wound. In order to know whether or not the antiseptic treatment could be applied to infected wounds, it became necessary to study the infection both of recent and infected wounds and determine the possibility of bringing the antiseptic into contact with the microbes.

A.—Topography of the Infection.—1. The topography of the infection was first studied in fresh wounds, superficial or deep, with or without fractures. The smears were taken in different places, around projectiles, fragments of clothing, splinters of bone, and on their surfaces, and examined microscopically and cultured.

In the first few hours the smears were generally negative, but the cultures were positive. The apparent sterility of the smears was due to two causes—dilution by the blood of the microbes and their relative infrequency in the early period of the infection, for they need time to multiply.

At the end of twelve hours the bacteriological examination showed bacteria more constantly and in greater numbers. The wounds showed some reaction and the polynuclear cells became more or less numerous.

In twenty-four hours the topography of the infection had changed considerably; the bacteria were no longer localized on the surface and around the foreign bodies, the smears showing their presence throughout

the greater part of the wound. At the same time an increase of the polynuclears was noted. That is, in the first twenty-four hours there was a multiplication of the microbes on the surface and in the vicinity of the foreign bodies, especially pieces of clothing, and later their diffusion in the limits of the wound. The difference bacteriologically in a wound from the fifth or sixth hour to the twenty-fourth hour was due to the rapid multiplying of the microörganisms.

The study of the numerous wounds showed that the organisms generally remained on the surface rather than penetrating deeply into the intermuscular spaces or the lymphatics. They invaded blood clots and devitalized tissues, and they followed extravasated blood in the vascular tracts and thus could reach the fractured bones. Habitually, however, in the first few hours, sometimes the first few days, they remained on the surface, that is, within reach of a solution, if such a solution was introduced under favorable conditions. This fact was well demonstrated in the wounds. When the antiseptic solution was brought into contact with the infected surface the number of bacteria rapidly diminished and the wound shortly became aseptic.

Suppurative wounds, therefore, were sterilized within twenty-four hours; the deeper, even accompanied by compound fractures, in five or six days. It was possible indeed when the treatment had been applied at the start to close such wounds by deep sutures and get results comparable to those of primary union.

2. Suppurating Wounds.—During the period of suppuration it was generally more difficult to bring the antiseptic in contact with the microbes, but, depending on the form and nature of the wounds, microbes were more or less easily influenced by the liquid. The chief difficulty was in dealing with necrotic tissue and sloughing tendons and aponeuroses, which prevented the action of the antiseptic on the microbes, with persistency of infection. Re-infection is, of course, more probable in such wounds, rendering it more difficult to obtain primary union after suture. It is therefore most important to sterilize the wound at the earliest period of infection.

B.—Preparation of the Wound for the Introduction of the Antiseptic.—This preparation consists above all in the mechanical cleansing of the infected regions. Free incisions of the soft parts permit of such a cleansing even in compound fractures. It is known that the pieces of clothing, projectiles, detached bony fragments, blood clots, and necrotic tissues harbor the bacteria and protect them against the antiseptic. Therefore, all such foreign bodies must be carefully sought for and removed. Fragments of clothes are the principal source of infection. Necrotic tissues are the favorite habitat of the gas bacillus. Systematic resection of all the tissues, skin, aponeurosis, and muscles which are devitalized, as practised by Depage, is an excellent procedure and should be generally employed. The surfaces of bony cavities in which pro-

jectiles have been imbedded should be scraped or resected. It should be noted that tampons placed in wounds efficiently protect microbes against the action of the antiseptic.

Incisions should be planned to expose all recesses of the wound as much as possible. The liquid must penetrate everywhere and remain in contact with the infected surface so long as necessary; that is, the weight of the liquid plays an important part. Wounds which can be filled as a vase are most suitable for sterilization (Fig. 3[1]). Therefore, incisions should be preferably located on the anterior surface of the limb without a posterior counter opening, thus retaining the liquid in the cavity and completely bathing its walls.

I. TECHNIC OF THE MANUFACTURE OF DAKIN'S SOLUTION

One of the essential conditions for the sterilization of wounds requires, as is well known, a substance which can be used a long time on the wounds in a fixed concentration without producing irritation. The proportion of alkali in Javel water and in Labarraque's solution is capable of dissolving the skin if contact is sufficiently prolonged. Dakin, therefore, sought to obtain a solution free of caustic alkali, and the hypochlorite contained should strictly fall between 0.45 and 0.50; below 0.45 the solution is not sufficiently active, above 0.50 it is too irritating. The earlier solution of Dakin has been modified by Daufresne. It is as follows:

To make 10 litres of the solution:

1. Weigh exactly chloride of lime, containing 25 per cent. of active chlorine, 184 gm.; dry carbonate of soda, Solvay, 92 gm. (or crystalline carbonate of soda, 262 gm.); bicarbonate of soda, 76 gm.

2. Into a 12-litre jar put the chloride of lime and 5 litres of ordinary water. Stir vigorously two or three times and let it settle over night.

3. Dissolve the carbonate and bicarbonate of soda in 5 litres of cold water.

4. Pour the whole solution of salts of soda in the vessel containing the macerating chloride of lime. Stir vigorously for a minute, then let it settle to allow precipitation of the carbonate of soda.

5. In half an hour siphon off the clear liquid and filter it with double filter paper to obtain a perfectly clear fluid, which must be kept in a cool place and in the dark.

The antiseptic solution is then ready for surgical use. It should contain 0.475 of the chloride of lime, with small quantities of neutral soda salt. It is definitely isotonic to blood serum.

The proportion of 184 grammes of chloride of lime to 10 litres of water corresponds to a product of good average quality (25 per cent. of active chlorine), but variations from the above are frequently encountered.

Daufresne has constructed a chart which gives the proper proportion

of ingredients according to the amount of active chlorine contained in the chlorinated lime as determined by titration.

Titer of chlorinated lime	Chlorinated lime, Gm.	Anhydrous sodium carbonate, Gm.	Sodium bicarbonate, Gm.
20	230	115	96
21	220	110	92
22	210	105	88
23	200	100	84
24	192	96	80
25	184	92	76
26	177	89	72
27	170	85	70
28	164	82	68
29	159	80	66
30	154	77	64
31	148	74	62
32	144	72	60
33	140	70	59
34	135	68	57
35	132	66	55
36	128	64	53
37	124	62	52

Preservation of the Solution.—Solutions of hypochlorite do not maintain their stability indefinitely, especially if exposed to light. Therefore, they should be kept in a dark place and should be made fresh as often as possible, at least every 10 to 15 days. (In large clinics this solution is made, and probably wisely, daily.)

Sources of Error.—By following the rules laid down by Dakin and Daufresne the solution of hypochlorite of soda always fulfills the requirements. Experience has shown that in some hospitals where Dakin's solution was said to have been employed there was used frequently under this name variable mixtures, more or less dangerous. These defective solutions which irritate the tissues and fail to sterilize wounds were the result of more or less gross technical faults.

It is important to note that the details of the technique as described must be strictly followed if one wishes to obtain a Dakin's solution of characteristic properties, for the technic of the sterilization has been calculated on the use of a liquid containing a concentration of the properties of the Dakin's solution so that any modification of this solution robs the method of its precision and efficiency.

TECHNIC OF THE STERILIZATION OF WOUNDS

I. *Mechanical Cleansing.*—The first part of the treatment consists in preparing for the penetration of the solution into the wound by surgical intervention and mechanical cleansing of the wound. This intervention is indispensable in order to effect intimate contact of the antiseptic and the bacteria.

1. The Time of the Mechanical Cleansing.—The surgical intervention

and the mechanical cleansing are carried out as soon as possible after injury. Every infected wound passes first through a period which may be termed pre-inflammatory—the various local symptoms being slight or absent. It is essentially the period during which, as far as possible, necessary intervention must be performed.

2. In from twelve to forty-eight hours, sometimes later, the inflammatory period begins, with elevation of temperature and obvious local manifestations of infection. This period may last for days or weeks. While the patient remains in this condition surgical intervention such as one would have done in the first twenty-four hours is not indicated. Free incisions and a prolonged search for foreign bodies or detached

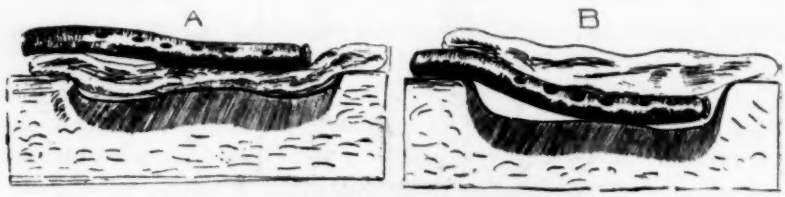

FIG. 1.—*A*, defective application of tube; *B*, correct application of tube.

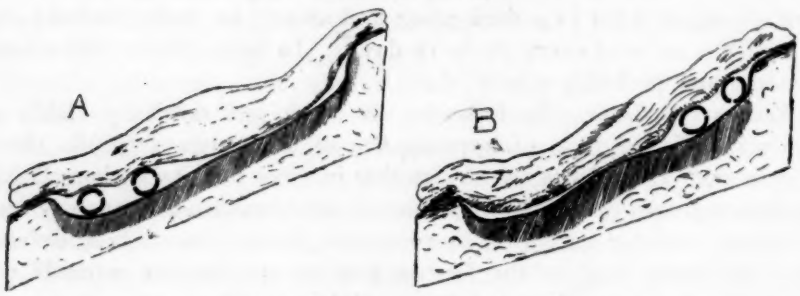

FIG. 2.—Oblique wound. *A*, tubes wrongly applied at bottom of wound; *B*, tubes correctly applied at top of wound.

pieces of bone may provoke a septicæmia or at least an aggravation of the pain and the local phenomena.

3. When the period of acute infection is over and suppuration has begun, such search and procedures may be done with much less danger. Osteomyelitis has, however, sometimes begun and the cleansing of the wound is no longer so efficacious as at first. In other words, the most valuable time for operation is the pre-inflammatory period.

II. *The Technic of Mechanical Cleansing of the Wound.* — 1. Both a general examination and a careful local examination must be made before intervention in order to determine the possibility of such intervention as well as its extent and the time required. Armed with such information, one proceeds as soon as possible to the mechanical cleansing of the wound.

2. Anæsthesia.—A general anæsthetic must always be employed. In certain cases spinal anæsthesia may be used.

3. Incision and Cleansing of the Wounds of the Soft Parts.—The skin is sterilized with tincture of iodine. Wounds of entrance and exit too small to permit any examination of the course of the foreign body must be enlarged. It is necessary to inspect the entire field visually, especially when a fracture exists.

No hesitation need be felt in making large incisions, as in a few days they can be closed. A large incision of the soft parts generally permits of early closing.

(a) An excision of the contused portions of the tract is carefully performed. Depage and his followers deserve credit for showing the

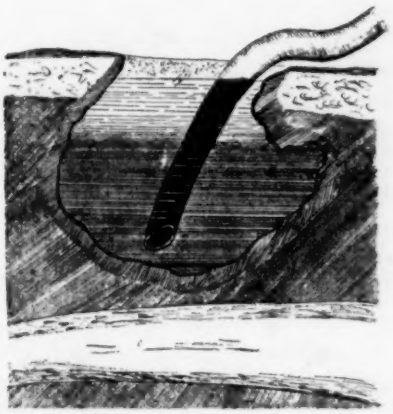

FIG. 3.—Wound with opening on upper surface filling up as vase.

great usefulness of pretty complete resection of the whole tract of the missile.

(b) Hæmostasis.—This must be performed very carefully, and it is important to verify the extent of extravasation of blood into the cellular spaces, especially when there has been a wound of a large vessel. Infection spreads with great ease under such conditions and may be of a particularly serious nature.

(c) Extraction of Projectiles and Fragments of Clothing.—If a wound is cleansed within a few hours after injury and the foreign body is small, it is generally easy to find, as the eye can follow the route of the projectile easily. It may be necessary to have recourse to some of the numerous and useful forms of apparatus for the location of foreign bodies. It is even more important to remove the fragments of clothing.

(d) Drainage.—Free drainage must be established, but differently from the customary methods. Counter openings on the dependent surface should not be made lest the antiseptic solution escape from it.

4. Cleansing of Wounds Complicated with Fracture of Articular Lesions.

(a) Cleansing of the Site of Fracture.—Incisions which serve for exploration and cleansing of fractures must always be very large. In fractures of the femur it is particularly important to make a large incision and separate the muscular bundles in order to follow the bony fissures to their full extent. Loose spicules of bone are often found between the fractured surfaces and in the medullary canal. These should be removed. The medullary canal is explored in longitudinal fractures and the marrow should be removed All fragments adherent to the periosteum are preserved, as experience has shown that fragments so treated are sterilized without sinuses and become readily united. On the other hand, the very free removal of these fragments so often performed in the field ambulances has given deplorable functional results. Bony lesions, often the severest, should not be submitted to immediate amputation except in extensive crushing of the bone or in the destruction of the vascular nervous bundles. In this way it is possible to preserve limbs which otherwise would be destined to amputation.

(b) Cleansing of Articular Lesions.—When the synovial membrane alone is affected the projectile is removed and the articulation emptied of blood. The infected region is isolated from the rest of the region by compress or suture, and the instillating tube is placed at the site of the foreign body. If the bony lesions are very extensive, resection may be necessary. Primary articular resection must be made circumspectly, for a chemicotherapy often results in healing of extensive lesions which under any other treatment would require resection.

INFLAMMATORY PERIOD

The inflammatory period generally begins in twenty-four to thirty-six hours—sometimes later. Two forms of infection are observed, the gangrenous and the phlegmonous. The first is of a more rapid evolution.

Our line of conduct will vary according to whether the infection is gangrenous or phlegmonous.

1. *Gangrenous Infection.*—This occurs in three forms—septic, grave local form, and the gaseous phlegmon.

(a) The septicæmic form requires immediate amputation, giving the patient what little chance there is for preservation of life.

(b) Local Gas Gangrene.—There are two forms, the superficial and the deep. The superficial yields readily to free incisions and chemical disinfection. The deeper form affects principally the muscles. While this form may yield to free incisions and chemical disinfection, it may be necessary to perform an amputation, which is done fairly close to the limits of the infection and the stump left wide open.

(c) Localized Gas Gangrene.—This is a more benign form, and

often becomes localized to a certain muscle. This form is particularly adapted to treatment with the Dakin solution.

2. *Phlegmonous Infection.*—The treatment may be summarized in saying that it is different from that adapted to the pre-inflammatory period. When the infection is well developed in a wound it must be limited at first by the simplest methods and leave for further procedures the surgical treatment necessitated by anatomical lesions and by projectiles.

Secondary Hemorrhage.—Such hemorrhages have occurred in certain hospitals as a result of employing an imperfect Dakin solution. The solution contains probably free alkali capable of provoking vascular ulcerations, as will Labarraque solution and Javel water. In wounds sterilized chemically, we never see secondary hemorrhages due to suppuration.

C.—Period of Suppuration.—Manipulation of wounds in this period is done more cautiously, as, in a way, it coincides with the inflammatory period. There are two types. One is covered with more or less sanguineous pus and accompanied with lymphangitis, swelling, and pain. This is the period of transition between the inflammatory period and the suppurative period, properly speaking. Unless there are urgent indications, these suppurating wounds must be treated in the same manner as wounds of the inflammatory period. The other type represents the older lesions. Thick pus escapes from the orifice covered by granulations, and the tissues show no œdema. Temperature is little elevated and shows marked variation. In this period surgical intervention is as possible as in wounds of the first type.

1. Chemical Cleansing.—In a great majority of these cases the wounded referred to the hospital at the end of from two to fifteen days have already been operated on. It is preferable not to interfere at once, but content one's self with minor procedures and the instillation of the Dakin solution as best one can.

2. Surgical Cleansing.—At the end of a little while in all compound fractures the improvement produced by the instillation of the antiseptic comes to a standstill. The wound then may be cleansed as if it were a fresh wound.

Chemical Sterilization.—The surgical cleansing is followed by application of the instillation tubes just as if it were a fresh wound.

D.—Cicatricial Period.—Cicatrization is not indicated at the end of infection. It is therefore prudent in these secondary interventions not to suture the wounds, but place in the depths one or two tubes for the introduction of the antiseptic liquid. In this way rapid sterilization of operative wounds is obtained and accidents due to re-infection are avoided. Later when the wound is determined to be really aseptic it may be closed.

RÉSUMÉ OF THE PRACTICAL APPLICATION OF THE CARREL METHOD

The method is applicable chiefly to the disinfection of fresh wounds, say within twenty-four hours from the time of infliction, more particularly compound fractures. Most of these cases will require cleansing under an anæsthetic, the thorough removal of all foreign bodies, fragments of shells, etc., with the trimming away of loose portions of tissue and the establishment of very free drainage. Instead of using gauze, ordinary rubber tubing, etc., for drainage, the wounds are filled with a large number of small rubber tubes to carry in the Dakin solution. Each tube is about the size of 16 French, perforated at the end with a number of small holes, and usually tied off at the open end to allow the fluid to run out of the smaller holes. The fluid is introduced at a pressure of 1 metre, and on account of the numerous holes of small size the fluid is forced out very much like a spray. Each tube is destined to spray a limited section of the wound, so a very large wound may require a dozen or more tubes. These tubes are coupled up by special branch tubes of glass devised by Carrel which lead to the tank containing the Dakin solution over the patient's bed. The dressings are applied largely in one piece and are made very light, the theory being not to have a big dressing into which the fluid simply accumulates.

The Dakin fluid is admitted by releasing the stopcock of the irrigator and allowing a prescribed quantity of the fluid to flow out into the small tubes every two hours. The amount will vary according to the number of tubes and the size of the wound. The object is to keep the wound damp without flooding it, and the exact amount of fluid has to be studied by the typical condition of each wound and by experience. If the fluid soaks through the dressing it shows too much is being used. The fluid is somewhat irritating and it is wise to protect the skin which may come in contact with it by cloths soaked in yellow vaseline. This procedure is better than applying the vaseline directly to the skin, and the yellow vaseline is more efficacious than the white.

The wounds are dressed daily, particularly to control the condition of the tubes and test their working efficiency. The tubes are changed or renewed according to the condition of the wound; if they do not become clogged or foul they may serve for several days.

Under this treatment fresh wounds do not develop infection, and there is practically no suppuration whatsoever. The average wound will become sterile inside of ten days. The sterilization of the wound is easily appreciable clinically from the total absence of reaction, suppuration, pain, redness, œdema, and the absence of constitutional manifestations, which are very marked.

The actual sterilization is demonstrated by the daily (or every other day) examination of the wound secretions for bacteria. From different parts of the wound a loop of secretion is taken, which is spread on a slide and stained by a suitable stain. At the beginning the number of

bacteria is infinity, but it is noted that the average number of bacteria in a given field diminishes, and usually quite steadily, until finally one may have to hunt through several fields before finding any.

Both Depage and Carrel have constructed charts to describe this per cent. of bacteria graphically. When the chart reads under the zero level for some time, say six days, and as the conditions lend themselves to it, the wound is "closed." Under this sterilization these wounds, after refreshing the skin edges, mobilizing flaps, etc., are sutured and heal very much as a fresh wound. Little is done in the way of refreshing wound surfaces excepting skin edges. A plug of obstructing granulations, if necessary, is shaved off.

These wounds heal in a manner that is simply indescribable. One has to see the behavior of these sutured wounds one's self to realize what happens. They heal with no more reaction from their appearance and manifestations than would be given by a wound which has been sutured on a cadaver—total absence of reaction, pain, swelling, redness, and even of infiltration around the wound edges. Dr. Dehelly, of Havre, tells me that he has closed 400 of these wounds with only 6 failures to obtain perfect primary union. Of these six mishaps, none was of any importance, and in some of these Dehelly said the fault was probably due to his failure to await complete sterilization, as evidenced by the bacterial count.

Carrel realizes that the method requires a good deal of personal attention, and is seeking to modify it by having an antiseptic which may be readily and continuously diffused all over the wound surface. He would like to use it very much as one does Beck's paste, which permeates every nook and cranny of a given cavity. For superficial surfaces he is using a chloralmine ointment. So far he has not been able to find a suitable medium to introduce into deep wounds.

During his recent visit last winter to New York, he told me that he was obtaining a full measure of success in the sterilization of old wounds, but the process of combating long-standing suppuration was very different from the prophylaxis of infection in recent wounds.

The Carrel method requires a proper appreciation of the principles of the treatment and an intimate knowledge of the technical details. As has been noted, the method consists of a series of steps, each one forming links in a chain, and the giving away of any one of these links destroys the usefulness of the whole structure. Much misconception exists about the method and it is supposed to be the application of a fluid containing hypochlorite of soda into wounds in some sort of fashion. These imperfect methods have been used, poor results have been obtained, and in some cases disasters. Consequently, the method has been condemned. It was most interesting to me to note last summer the divergence of views on the usefulness of the method. When I arrived at Paris before going to Compiegne, I found that the majority of the "high priests" of the surgical profession not only did not believe

in the method, but opposed it most acrimoniously. Investigation showed that the hostile party represented the party of ignorance; that is, I found that no one of the opponents with whom I discussed the matter had taken the trouble to go to Compiegne, sixty miles away, to study the method at its source; also, that some who had gone there had not realized the finer points of the technic or the necessity of scrupulously observing them.

I visited the clinic of a very excellent surgeon who enjoyed in Paris the reputation of having mastered the technic, and found (1) that he was not getting very good results, (2) that he was grossly violating some of the fundamental principles of the method. Commenting upon this to Carrel on my second visit to Compiegne, he smiled, and said, "The gentleman stayed here only an hour." Another surgeon who had employed the method, but not thoroughly and with consequent results, advised me not to stay any great time at Compiegne, as "It will only take you a couple of hours to get the whole thing."

On the other hand, every surgeon, particularly the Americans, who took the trouble to study the method with Carrel or Depage or Lyle became, without exception, profoundly convinced of the value of the method and its superiority to all procedures hitherto employed.

The particular pitfalls which I have observed are:

1. The improper preparation of wounds, and failure to remove foreign bodies, necrotic material, etc.

2. By failing to make free incisions and suitably placed incisions in which every portion of the Dakin fluid can come into direct contact with all portions of the wound.

3. Failure to utilize tubes of proper calibre with suitable perforations as regards size, number, and situation; failure to place them so that every portion of the wound is properly moistened by the solution.

4. Failure to introduce the fluid under the proper pressure, so that all the fluid shall run out as a spray and not trickle out of the first hole.

5. Introducing the fluid under too much pressure. Excess of pressure is produced (Carrel and Dehelly) either by too great an elevation of the container or with small-sized incisions which prevent the easy outflow of the fluid between the wall of the wound and the tube (Fig. 4[1]). This excess pressure is manifested by pain. If the introduction of the fluid at any time causes the patient pain it must be discontinued and the technical fault corrected.

In addition to pain too great a pressure may result in absorption of the fluid, with resulting hæmolysis and possibly death in a short time. It is quite possible that in certain wounds, as, for instance, an appendiceal abscess, in which a loop of gut presents, absorption may take place with disagreeable and perhaps fatal results if the condition is not recognized. On one occasion there was quickly produced a change in the patient's condition and transitory jaundice. So soon as these manifestations appeared treatment was discontinued and the patient recovered.

6. Failure to place the tubes so that the fluid runs down hill and not up hill, a very frequent source of error, as I have found (Fig. 2[1]).

7. Failure to locate the perforations in the tubes so that they are all contained within the wound, not allowing the fluid to run out on the skin.

8. The use of too much fluid so that the wounds are drowned out and the fluid runs out on the skin with disastrous results.

9. The use of packing and tampons in the wound, which prevent free access of the fluid to the bacteria (Fig. 1[1]).

10. Failure to realize the evanescent character of the hypochlorite and its dilution by wound secretions—in that the wounds are not moistened regularly every two hours, as prescribed.

11. Failure to protect thoroughly the skin with a yellow vaseline smeared on gauze.

12. Failure to use the correct solution, which is usually lacking in

FIG. 4.—*A*, orifice too small—fluid is under pressure and cannot escape; *B*, proper sized orifice, permitting the free escape of fluid between wall of wound and tube.

strength, there being only one-half per cent. margin between efficiency and danger. In addition to the difficulty of getting perfectly correct proportions of the active chlorine, there is a very grave danger of over alkalinity, giving rise to burning and caustic action in the wound. The proper solution should *never* cause any pain. The appearance of pain should be a signal for the immediate discontinuance of the solution and an investigation of its accuracy.

As regards the results of the Carrel method in my service since its introduction last October, I have not been able to give it a very thorough trial, as I have lacked the more ideal cases, namely, the extreme degrees of trauma, especially compound fractures. I have had to limit it mostly to old suppurations. I can say in general that, while the method so applied has not worked any miracles, I feel, and I think I am supported by my colleagues, that we have been able to control suppuration more promptly than by any other method, and certainly the results of the bacterial examinations as recorded in our charts show in practically all instances an immediate and constant diminution of the bacteria.

The following are a series of consecutive cases depicting the very consistent drop in the bacterial count after institution of the Carrel method:

[1] Illustrations from Carrel and Dehelly.

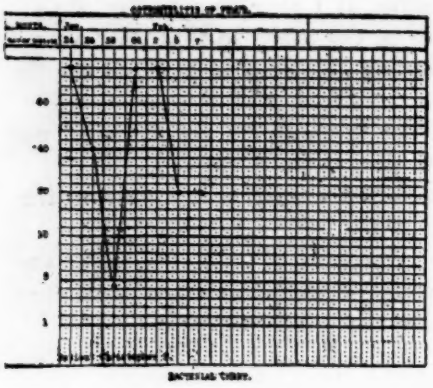

FIG. 5.

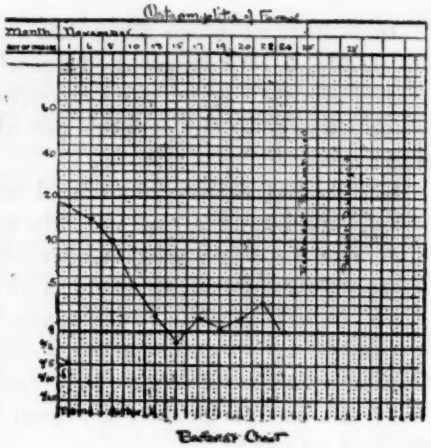

FIG. 6.

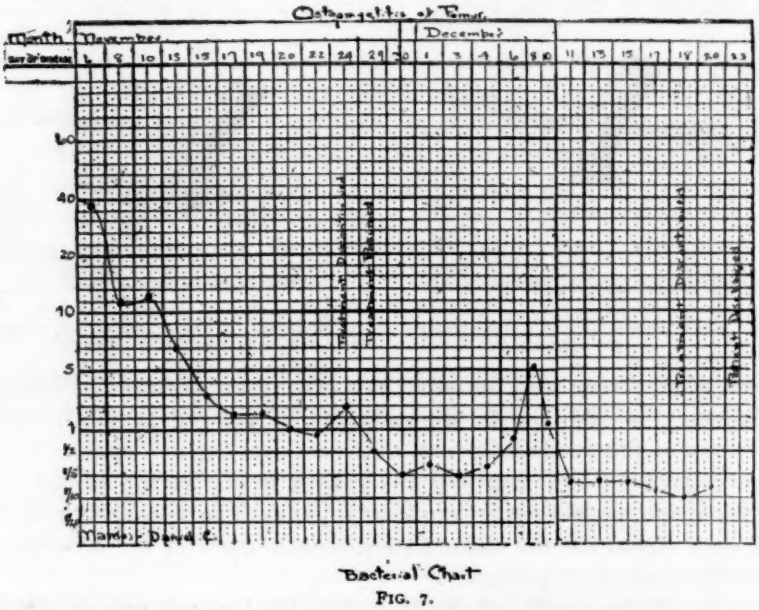

FIG. 7.

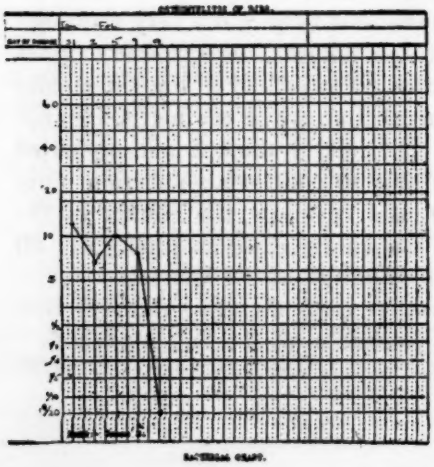

FIG. 8.

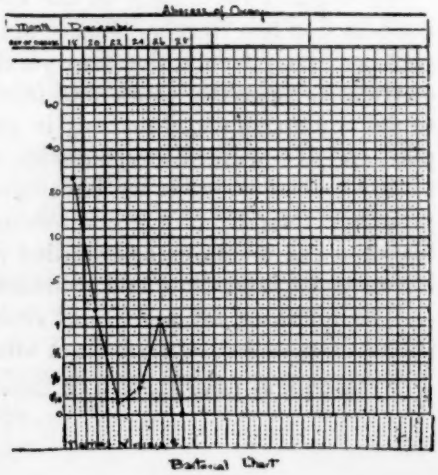

FIG. 9.

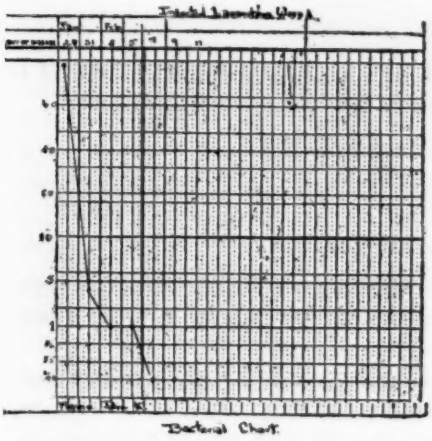

FIG. 10.

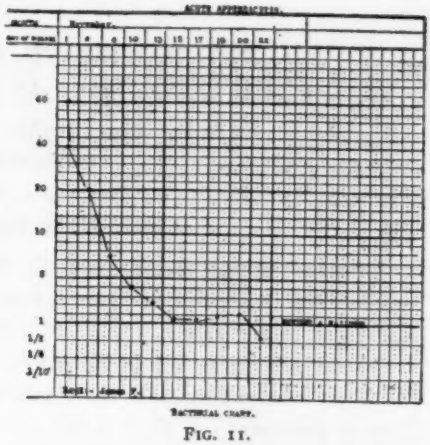

FIG. 11.

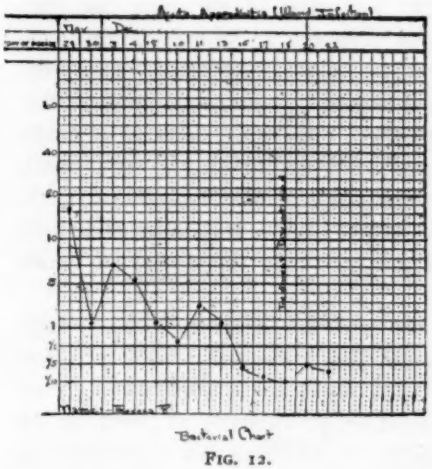

FIG. 12.

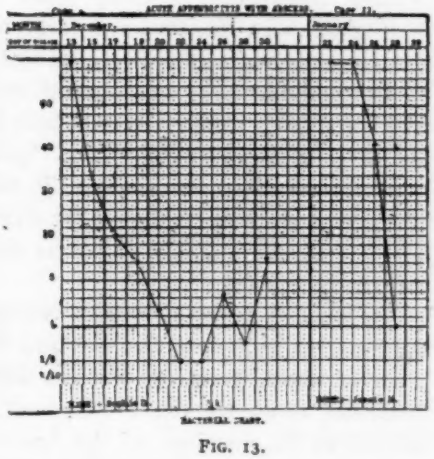

FIG. 13.

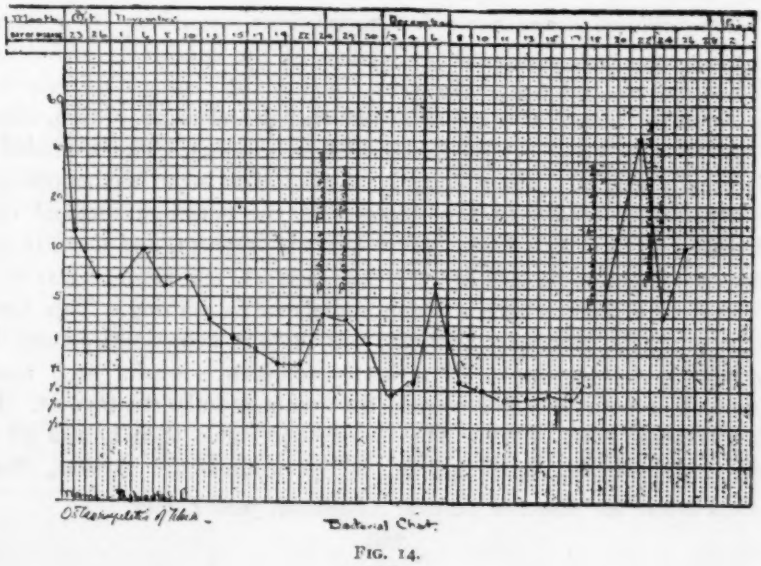

FIG. 14.

OBSERVATIONS UPON SHOCK, WITH PARTICULAR REFERENCE TO THE CONDITION AS SEEN IN WAR SURGERY*

By Edward W. Archibald, M.D.
of Montreal, Canada
and
Capt. W. S. McLean, C.A.M.C.

During the past two years I (E. A.) had the good fortune to spend eighteen months in service in France, four months of which were spent in a hospital close to the front.

There are three kinds of service in the surgery of the present war: (1) That of the hospitals close behind the front line, called by us casualty clearing stations; (2) that of the base hospitals in France, which are usually situated from thirty to sixty miles back; (3) that of the base hospitals in England. In England one sees chronic surgery; at base in France one sees subacute and acute infections, and one goes continually shrapnel-hunting.

But in the casualty clearing stations one sees three conditions in particular which are rarely or never seen at base far back. They are abdominal wounds, the early and severe effects of "gassing," and finally shock; and shock is seen to an extent unparalleled in the experience of any surgeon at home. The very frequency of it, and the terrible nature of it, were impressive, and, not less so, our inability to rescue such patients when the degree of shock was really serious.

In what is here said to-day we do not pretend to bring forward anything particularly new, but we have thought that a general review of these cases of shock from the clinical side, with notes upon such methods of treatment as we are able to carry out, might be, particularly at this time, of interest to the members of the Association. In addition, we would like to resume, briefly, the prevailing theories concerning shock, and to offer in the light of our clinical experience a few suggestions concerning these theories.

In order to get a better comprehension of the conditions under which we did our work, let us relate, very shortly, the manner of evacuation of the wounded from the trenches to our casualty clearing station, situated some six to eight miles behind the front-line trenches. The wounded soldier is usually carried without delay by the battalion stretcher bearers down a communicating trench to the dug-out of the battalion medical officer situated 400 or 500 yards back. Here first aid is given, and then, if possible, the man is carried, still by stretcher bearers, for another 400 or 500 yards back to a point where a horse ambulance is waiting. This can, of course, usually be done only at night, and there is sometimes a long delay while waiting for darkness. The horse ambulance works back another mile or so to a point where it is safe for motor ambulances to wait. Here another transfer takes place. The motor ambulance then brings its load to field ambulance headquarters, or, if the wounds are serious, straight

* Read before the American Surgical Association, June 1, 1917.

to the casualty clearing station, situated anywhere from five to ten miles behind the trenches, and usually at what is called rail-head. Here the wounded man finds his first good resting-place. The casualty clearing station has, on its establishment, accommodation for 250 stretchers, which is expansible up to 500 or more. During the past year and a half a limited number of proper hospital beds, from thirty to fifty, have also been provided by the army for the more serious cases, while the less serious ones are cleared the next day, or even the same day, by ambulance train down to base. It thus happened that we had under our care at any one time some 20 to 40 really bad cases. These were chiefly wounds of the brain, of the lung, and of the abdomen, together with bad compound fractures and multiple soft part wounds. Among all these shock was frequent.

Now, we would call your attention particularly to the fact which is not always appreciated, that the transport of the wounded from the trench to the casualty clearing station is frequently a most trying experience. The soldier, before he is hit, is often in a state of fatigue, and not seldom during the winter is he wet and cold into the bargain. Add to this the jolting of a stretcher journey of 1000 yards down a muddy, slippery, uneven communication trench; add to this the bumping of a horse ambulance along the roads of France such as they are at present well up toward the lines; add to this the transfer to the motor ambulance and a vibratory ride along the stone pavés of that country; add to this a couple of changes of dressing of a painful wound; add a certain loss of blood even in the best cases; add finally the effect of cold, and you get a composite set of circumstances for the reduction of the patient's resistance than which even Dr. Crile could ask nothing better. The wonder to us was that we did not have more shock than we did. We may dismiss this aspect of the question by saying that an investigation of the cases showed quite clearly that a great many of the sufferers from shock gave a history of great exposure to cold and to fatigue during the time which elapsed from the receipt of their injury to their arrival in hospital. The influence of these factors was quite unmistakable. A French surgeon, M. Santy, in a very recent number of the *Lyon Chirurgical,* has called particular attention to this fact, and he was able to fill in a lacuna in our own experience. He had served both in the advanced dressing station and in what corresponds in their army to the casualty clearing station, and he says that, apart from those who die on the field, the occurrence of shock in the wounded soldier when seen soon after infliction of his wound, is extremely rare, but that the loss of even a strictly moderate amount of blood, together with the distresses of transport, will frequently push a wounded man, previously in good condition, into what he calls secondary shock, before his arrival at the hospital. [From what has been related to me by my friends serving with battalions and with advanced field ambulances I am quite sure than M. Santy is right. There is a tale told me, for instance, by a friend of mine of a man whom he saw wounded in the abdomen, actually running down the communication trench

to seek help, with the bulk of his small intestine hanging out in front of him. That man was not, at first, in shock. E. A.]

One need spend but little time on the definition of shock. Although the physiologists have for years past been trying to define shock for us, we clinicians are fairly well agreed upon the matter. The picture was a sharp clinical one before physiology was. The low-tension pulse, usually rapid, sometimes not, the shallow breathing, the pallor, sometimes going on into a light cyanosis, the lack of apparent suffering, the carelessness as to one's surroundings, the preservation of a clear though lethargic mind up to the very last—these things are all familiar to us, and these were the symptoms which, in our experience, were constantly present, whether the injury concerned the bones and soft parts or the abdomen. Let us remark in passing that wounds of the chest and of the head very rarely, indeed, presented the symptoms of shock. In going over the notes of our shock cases we find that practically all were wounds of the locomotor system or of the abdomen. Of these we have for consideration 44 cases, of which there were 32 abdominal, 10 multiple wounds of the extremities, with or without compound fractures, and 2 chest cases. We tried to keep decent records of our bad cases, particularly with regard to blood-pressure, but you will understand that these notes were not infrequently somewhat fragmentary on account of the press of work. From the review of these observations we have picked out a few main facts meriting discussion.

The very serious influence of fatigue, cold, and exposure as aids in the production of shock has already been referred to.

Out of 25 cases, moderate and severe, in which reference is made to this point, there were only 2 in which the patient was said not to have suffered from it. Roughly speaking, the degree of fatigue and exposure ran parallel with other serious symptoms of shock, although not always corresponding with fall in blood-pressure. In practically all the recovery cases, while there was some fatigue, the patients were warm.

Temperature.—Guy Kinnaman in an article some years ago pointed out the serious effects of shock upon the temperature. We found uniformly a serious fall. His work was done on animals. We have found in these clinical cases, and also in a small series of experiments (E. A.), a confirmation of his general results. Very frequently, if the patients were in marked shock, the clinical thermometer would not register, which meant that the temperature was somewhere below 92°. Of 12 cases in which the temperature was low to this extent, death within a few hours took place in 9. There were only 3 recoveries, and of these 2 died later of gas gangrene.

Pulse and Blood-pressure.—If shock were marked, as judged by the general signs, blood-pressure was practically always below 75, and occasionally it could not be got at all. Out of 17 cases with a blood-pressure below 75, only 3 rallied from shock, and these all died in two or three days from gas gangrene. All the rest died within a few hours after admission or after operation. The pulse was nearly always rapid—that is,

110 or over. This probably has the same significance as in hemorrhage—a lack of sufficient blood to the ventricle in diastole. Respiration was usually increased by six to twelve in a minute, *i.e.*, 24 to 32, and was always shallow.

Hemorrhage.—Hemorrhage, of course, was apt to complicate the picture. It is well known that even a moderate loss of blood tends to predispose to or aggravate shock. However, there was a considerable number of cases in which hemorrhage was either absent or very slight. In these apathy and cyanosis as opposed to restlessness and blanching were marked. Another striking difference lay in the effect of intravenous salt or of transfusion—helpful in hemorrhage, useless in severe shock.

It was frequently necessary, on account of infection or bleeding, or, in abdominal cases, the presumed danger of peritonitis, to operate soon after admission in the middle of shock. It can easily be imagined how serious such operations were. In a general way, operations aggravated shock very definitely. The old dictum that one should wait for the rally seemed to me to be absolutely confirmed by our experience.

Treatment.—Treatment under the conditions in which we worked was frequently difficult to carry out thoroughly. We were often short-handed for the extreme demands which such cases made upon one's service. However, we did manage to give a great deal of salt solution; we learned to prefer to give it intravenously rather than under the breast; in the latter case it was apt to be absorbed far too slowly to do any good. Rectal salines were often given in addition. Our experience confirmed what we all know, that the effect of intravenous salt is very transitory. It rarely held up the blood-pressure in serious cases more than a couple of hours, often much less. If the trouble were chiefly hemorrhage, results were much better. A number of cases with a blood-pressure of 70 or over were saved by intravenous saline. In a certain number we gave, following Hogan, a colloid solution of 25 grammes gelatin in a litre of saline. Its effect lasted three or four times as long; nevertheless, in cases of bad shock, it did not avert the fatal outcome; in hemorrhage it was more effectual than the saline alone.

Transfusion of blood was done in 3 cases, using the citrate method, 16 to 20 ounces being given. Its effect was disappointing; while the color was improved and a slight rise of blood-pressure was got, it had no more permanent effect than the gelatin or salt. In this the contrast with its truly life-saving action in cases of pure hemorrhage was most striking; after all, in shock we are not dealing with lack of blood alone, but with some complex mechanism by which blood is continuously withdrawn from the circulation, and to transfuse simply means that your transfused blood goes lost with the rest.

The head-low position was, of course, always used, but without obvious influence save in light cases. Pituitrin was freely employed, and always brought up the pulse to a certain extent; but this was often transitory, and, on the whole, we concluded that it had no real beneficial effect in bad shock. In moderate shock it was of distinct value. Theoretically it ought

to do good. The constriction of the peripheral arterioles now proved to be present in shock is very possibly a protective measure to compensate for lack of blood volume. It is, perhaps, indicated to increase this if possible, but adrenalin is contra-indicated because of its constricting action on liver capillaries, and we cannot afford to have an engorged liver obstructing free return from the splanchnic area; besides, adrenalin is too transitory.

In 2 cases we tried the opposite line of treatment, giving amyl nitrite in order to dilate the tight arteries of the periphery. There was a very fleeting improvement in the color of the skin, but no delay in the fatal exit. In another case we tried alternate rhythmic compression of the abdomen for an hour, but this had no good effect. In another case we rigged up a see-saw arrangement and kept up alternate head-low and horizontal positions for some time. We concluded that the permanently head-low position was better. Hot-water bottles were freely used of course. The majority died in spite of all our efforts.

Interpretation of Blood-pressure Readings.—We used the auscultation method with the Tycos instrument.

Systolic blood-pressure is not so important in advanced shock as diastolic. Systolic may occasionally be up near 100, and diastolic be low, 20 to 40. This spells shock.

If an intravenous saline raises a low systolic, but fails to raise the diastolic, shock is still present and unrelieved, and the patient will die. [This I have also seen in animals during the terminal stages. E. A.] The systolic peak under such circumstances does not mean much.

If the sharp click of the systolic is weak or distant throughout, there is danger.

If the systolic sound is first heard only during expiration, and becomes continuous only some ten to twenty millimetres lower, such cases are always in shock and blood-pressure is low. They frequently die.

A man with the ordinary symptoms of shock, whose systolic blood-pressure is 65 or below, rarely recovers. One whose blood-pressure is low from hemorrhage alone will frequently recover. Salt solution does no good in the first, but does good in the second.

Ordinary hemorrhage, unaccompanied by fatigue, or cold, does not reduce pressure materially. A large amount of blood must be lost to lower it to 75. Often we would find the abdomen full of blood, by measurement 45 to 55 ounces, and blood-pressure would be normal if shock were absent.

The Cause of Shock.[1]—Space fails me to resume all the work that has recently been done. I must content myself with making categorical statements. Assuming that shock is due to circulatory failure, we have to ask ourselves two question: (1) At what point of the circulation is the failure primary? (2) What is the cause of the failure at that point?

Let us briefly consider all the systems concerned:

1. The heart is strong enough.

[1] The rest of the paper is by E. A.

2. The vasomotor centre is strong enough.

3. The arterial tree is strong enough.

4. The peripheral capillaries are empty (blanched) or contain half-stagnating blood (cyanosed).

5. The peripheral veins show low blood-pressure and are comparatively empty, as shown by the difficulty in finding veins in the arm for infusion, and in animals by direct observation (*e.g.*, the smallness of femoral vein in experiment of May 14, 1917, when exposed for injection of gum solution).

6. The splanchnic veins are sometimes moderately full, sometimes not. This is particularly true of animals, in which marked engorgement of this area is not present unless shock has been produced by manipulation of the viscera.

7. The tissues of the dog's intestine become markedly œdematous when shock is produced by manipulation of the bowel; also, though to a less extent, when produced by mere exposure of the bowel.

8. The lungs do not give out, though they contribute by shallow inspiration and prolonged expiration, with consequent lack of suction, to the diminution in the return of venous blood to the heart.

9. The brain is clear to the end.

10. The muscular system is relaxed and contributes by lack of work to stagnation of venous blood.

11. The adrenals, according to Bedford, are not exhausted, but, on the contrary, deliver an increased amount of secretion during profound shock, right to the end.

Now as to blood-pressure. While a low blood-pressure is one of the most constant signs of shock, it is not the essential thing, let alone the cause of it. We have focussed our attention far too much on blood-pressure, so much so as unconsciously to have come to regard it as almost causal.

To raise peripheral blood-pressure accomplishes nothing save a mechanical effect. A raised blood-pressure is not life. In bad shock, the saline runs into the tissues from the blood, and you are left as poor as before. Even blood, let alone Hogan's gelatin solution or Bayliss's gum acacia solution, will do but little more; it, too, disappears into the tissues. Dolley kept up blood-pressure in shocked dogs to near normal for two or three hours by repeated transfusions of blood; but at the end of that time blood-pressure fell rapidly, and then the dogs died of shock in ten minutes. The fundamental trouble was not removed. Janeway and Ewing bled two dogs into one shocked dog. The latter accommodated all this blood and continued in shock, while the two donors were left exsanguinated.

What the nature of the cause of this loss of fluid from blood to tissues is can as yet only be guessed. I do not believe it is hyperpnœa from *pain* and consequent general acapnia as Henderson suggests. Our patients all received ½ grain of morphine at the Field Ambulance, and it did not prevent shock. It may be a local acapnia when bowel is long exposed, but primarily it is more probably in the nature of an inhibition by which capil-

lary tone is lost and the balance of the local chemical changes between blood and tissue or cell fluids is upset, perhaps chemically, perhaps by stagnation and insufficient oxidation. I imagine cold, fatigue, and wet may assist such an upset. Death by freezing, for instance, is one form of shock, and shock may be brought on in animals by cooling the blood, as Mann showed. But on top of that comes severe local injury, loss of blood, wounds of the mesentery—all combined may let loose reflex inhibition.

Recent English work has demonstrated in shock a serious loss of plasma into the tissues, with consequent rise in the hæmoglobin count and the viscosity of the blood in the vessels. In shock produced by histamin, Dale and Laidlaw showed that one-half the plasma had disappeared into the tissues. The same is true in cholera shock. Captain Marshall (personal communication) has found an increase of 20 per cent. in the hæmoglobin count in shock cases at a Casualty Clearing Station. On the other hand, obvious œdema at postmortem is not always, or even often, seen unless large amounts of saline have been infused. I suspect it may be in traumatic shock what Krehl suggested was the case in fever, that the extra water is retained chiefly in the cells themselves and not in the tissue spaces.

By exclusion, therefore, it appears to me that the trouble begins in the vast capillary system, that enormous area of marshy ground in which fluid has such a chance to stagnate. We know, with fair certainty now, from the work of Cotton, Slack, and Lewis, that the capillaries possess active contractility. Dale and Laidlaw believe that in shock produced by histamin the tone of the capillaries is lost and blood stagnates. For the present I accept this as the point of primary failure in traumatic shock. Pallor, followed in bad cases by cyanosis, is an outstanding feature in our observations. The veins no longer receive enough blood. If they did we could overcome shock by gravity and by compression, which we usually fail to do. Consequently, the failure in the venopressor mechanism (Y. Henderson) is a secondary effect; likewise the gradual failure of the heart and of the coronary supply, all of which assist in the establishment of a vicious circle. The capillary failure leads to insufficient oxidation, which results in asphyxial acidosis. "The acid substances thus formed cause the proteins of the tissue to imbibe water from the blood in much the same manner that fibrin swells in dilute acids. Hence the fatally rapid transudation of fluid from the blood-vessels" (Henderson).

This work suggests that hypertonic salt solution at twice decinormal strength would be of some promise. Its chief effect would naturally be to call back into the blood the plasma lost to the tissues. But very possibly it also acts by restoring capillary tone. I am told that some encouraging results have recently been obtained at the front with it. I have no clinical experience, but in one of my animals, reduced to deep shock by abdominal exposure, the tongue, up to then quite cyanosed, recovered quickly with hypertonic salt a normal pinkish tinge, obviously a local effect on capillaries, inasmuch as blood-pressure previously at 35 was raised only to 50.

INJECTION OF THE GASSERIAN GANGLION FOR NEURALGIA OF THE FIFTH CRANIAL NERVE*

By George Tully Vaughan, M.D.

of Washington

Cutting with or without resection of the affected nerves for neuralgia is a comparatively old method of treatment, as it was used by Astley Cooper, Velpeau and the elder Warren, but the method by injection of destructive substances into the nerve seems seldom to have been used previous to 1884, when Neuberg reported cases treated by injection of osmic acid.

It seems that Wright in 1907 was the first to inject the Gasserian ganglion, exposing the ganglion as if for removal and then injecting it with osmic acid, and later Rasoumosky used alcohol in the same manner.

Schlösser, Sicard, Ostwald, Härtel, Wright, Harris and Camp by degrees worked out the methods now used for injecting the ganglion through the foramen ovale from the skin.

According to Byrnes, Ostwald and Sicard, in 1906, suggested the subcutaneous way of injecting the ganglion. Pussep, in 1911, made the first though unsuccessful attempt by this method—at any rate he was so unfavorably impressed by the immediate effects on the patient—vomiting, headache, slow pulse and cyanosis—that he condemned the operation as unjustifiable. Four months later Taptas of Constantinople seems to have made accidentally the first successful injection into the ganglion while trying to inject the third branch. Wilfred Harris of England, working along the same lines and about the same time, improved the technic by inserting the needle through the lower part of the sigmoid notch, and in 1912 published seven cases. The operation is not very difficult, it is pretty sure to give relief for a time, perhaps permanently, and should be tried in all cases before doing a gasserectomy.

There may be some question as to whether or not it should be preferred to the Frazier-Spiller operation, as the latter operation preserves the motor functions of the nerve. Experience shows that injection is the safest operation—certainly as to life and probably also as to the bad effects produced on the eye.

Weidler says that in a series of over 300 cases of alcohol injections, in only one was there serious keratitis, whereas in seventy cases of gasserectomy a number of cases of keratitis occurred, and in four cases enucleation of the eye was necessary. This may not be a fair comparison as in few of these injections was the ganglion attacked. However, no surgeon would agree with the statement that injection of the ganglion is free from danger, and yet I know of only one death reported from it—that of Härtel from septic meningitis, probably due to an error of technic. The danger of

* Read before the American Surgical Association, May 31, 1917.

injuring some of the important structures that are so intimately related to the ganglion either by needle puncture or by the action of the alcohol when one is feeling his way in the dark, is certainly great, but experience shows that if such injuries are inflicted, they do not seriously injure the patient. The structures which are most liable to injury are the internal maxillary and middle meningeal vessels, the cavernous sinus, the third, fourth, and sixth nerves, the carotid artery and the under surface of the temporal lobe of the brain. The injury may be purely mechanical from punctures, laceration, or contusions, or it may be chemical from the action of the alcohol on the tissues, or it may even be the result of infection.

My cases are reported chiefly because it is only by observing the results in large numbers that we can reach a reliable conclusion as to the value of any remedy.

Case I.—Three injections. Woman, aged forty, with history of tic douloureux for fifteen years on right side and a slightly shorter time on the left side. All three branches affected on both sides, but especially the second. Ten years before Dr. Finney had removed the right infra-orbital nerve with only partial temporary relief. She is an intelligent educated woman and knew something about the surgical treatment of her trouble and came to me for the purpose of having both Gasserian ganglions removed—her suffering was so great. She was persuaded to try the method of injection first. With the patient in a half-reclining position under local anæsthesia, with a cork between the teeth in order to lower the sigmoid notch about half an inch, the graduated needle with blunt point was inserted on a line drawn from the lower part of the mastoid process to the lower part of the malar bone and carried inward through the lower part of the sigmoid notch slightly backward and slightly upward until the point entered the foramen ovale, indicated by the limitation in the lateral motion of the point by depth—4½ cm. —and in this case by the escape of a few drops of cerebrospinal fluid. The needle was pushed a little further till the total distance from the skin was 5 cm. The syringe was attached and 1 c.c. of novacaine with adrenaline was injected. In five minutes there was no conjunctival reflex on that side and 1 c.c. of alcohol was then injected and the needle was withdrawn.

The same procedure was then carried out on the other side. In fifteen minutes there was anæsthesia of the entire face.

Next day there was a return of pain on the right side in the region of distribution of the first and second branches, and, as this continued, another injection of the right ganglion was made one week after the first—exactly the same technic. This time there was wide dilatation of the right pupil which lasted two or three days. Complete relief followed this injection. Patient was cautioned to take care of the eyes on account of the danger of irritation from the lack of normal protective sensation.

Examined more than a year later, the conjunctivæ were a little con-

gested in both eyes, no trouble with the cornea. There was analgesia of the entire face though pressure could be felt. Patient had had no pain and expressed herself as well pleased with the result.

CASE II.—One injection. Woman, aged thirty-four, highly nervous, had suffered with pain in the right eye, ear, temporal region and side of the face. Has taken large doses of morphine for the pain. No disease of eye, ear or brain could be detected.

Right ganglion was injected. Temporary ptosis of upper lid and dilatation of the pupil followed and there was analgesia of that side of the face, but the patient still complained of pain but less in degree. The pain soon died off, but some ptosis and dilatation of the pupil remained when she was last heard from—about three months after the operation.

CASE III.—Man, aged fifty-six, with right-sided neuralgia of 5th nerve for which the infra-orbital had been removed ten years ago, giving relief to the middle of his face, but he continued to suffer in regions supplied by the first and third branches and came to me for removal of the ganglion. It was decided to try injection of the ganglion first. An attempt was made in the usual way but failed to enter the foramen ovale and only the third branch was anæsthetized. Five days later the attempt was again made, entering the needle half a cm. lower than before, when it was guided into the foramen with little trouble, the total depth being 6 cm. from the skin. One c.c. of 95 p. c. alcohol was injected. This gave complete relief, but it is yet too early to predict anything as to its permanence.

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EMPYEMA OF THE THORAX*

REPORT OF ONE HUNDRED CASES TREATED IN THE SURGICAL SERVICE OF THE WRITER, AT MT. SINAI HOSPITAL[1]

By Howard Lilienthal, M.D.

PROFESSOR OF CLINICAL SURGERY, CORNELL MEDICAL COLLEGE; ATTENDING SURGEON TO MT. SINAI HOSPITAL AND BELLEVUE HOSPITALS, NEW YORK

Before this Association, in 1915, the writer presented a paper describing his method of procedure in empyema of the thorax.

The keynote of the surgical treatment was full and complete exploration through a widely spread, long intercostal incision without resection of the ribs. In this paper it was distinctly stated that while standing for the principle of free exploration this operation might be performed as a second stage following the relief of cyanosis, dyspnœa or other threatening symptoms of intrathoracic pressure by a minor intercostal incision with tube drainage. It is to be clearly understood that while no single procedure is suitable in all cases our aim must be to secure a final result with no impairment of chest capacity.

Having now had the opportunity of observing one hundred cases treated in my service at Mt. Sinai Hospital, from March 25, 1914, to March 25, 1917, a period of three years, the time is considered ripe for reporting this experience and the conclusions which have been reached.[1]

To begin at the end I may say at once that with increasing familiarity the treatment of this condition as previously outlined has impressed itself more and more favorably upon me.[2] Moreover, other surgeons who have been present at these operations have expressed themselves as convinced and a number of them have adopted the method.

All patients suffering from empyema of the thorax and not previously treated surgically were operated upon regardless of the prognosis and regardless of the source of the pus.[3] No patient was refused because he was believed to be moribund, and this can be well illustrated by noting that one death occurred before the anæsthetic was administered and before an incision had been made, the end coming during the preparation on the operating table. This case, naturally, is not included in our list because no operation was performed. One patient with pyæmia, perforated metastatic lung abscess and suppurating osteomyelitis of the bones about the knee-joint died following an amputation of the thigh. This case is counted in our list. Two fatal cases of pyæmic

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[1] Since the report in 1915 two papers on this subject have emanated from this Service, the first by Lilienthal and Ware, "Recent Progress in the Operative Treatment of Empyema of the Thorax," Med. Rec., July 15, 1915; second, "The Trend of Surgery in Empyema of Thorax," by Martin W. Ware, Ann. Surg., March, 1917.

[2] The operations in the one hundred cases were performed by the writer, by Dr. Joseph Wiener, and by Dr. Martin W. Ware. A few cases were operated on by the House Surgeon under supervision.

[3] Those operated upon elsewhere and coming to us with thoracic wounds are not referred to in this paper.

abscesses of the liver with perforation into the chest are also included. One case of tuberculosis of the lung with perforating bronchiectasis still further swells our mortality rate, and all of these cases fall under the group of those which were operated upon by the procedure which I have taken the liberty of denominating Major Intercostal Thoracotomy.

Deducting these, instead of 100 cases with 23 deaths we would have 95 cases with 18 deaths, or 18.9 per cent. mortality instead of the 23 per cent. which my table shows—for I am not in sympathy with the sport of juggling with statistics.

It will be noted that the one hundred patients whose cases we tabulate represent 38 minor thoracotomies with 18.4 per cent. mortality; 44 major thoracotomies, many of them preceded by minor thoracotomy, death rate 27.2 per cent.[4] Resection of ribs with their periosteum and gauze packing in encapsulated empyema treated as if it were an abscess, 7 cases with no deaths. Resection and drainage by the old method 7 cases with 1 death, or 16.6 per cent. This is in reality one form of minor thoracotomy.

The 100 patients were divided between children and adults, 64 under twelve years of age, 36 over twelve years old.

Male patients predominated over females at the rate of about 2 to 1, or, in the last two years 25 females to 51 males.

Counting as we have all cases of empyema primarily operated upon and counting the deaths, no matter from what cause, the mortality shows a 5 per cent. improvement over the ten years with 299 patients reported recently from all the Surgical Services at Mt. Sinai Hospital.[5]

The patients who recovered remained in the hospital an average of about 37 days, a gain of one week over past records.

But now we come to a matter of the greatest importance where a most striking improvement is demonstrated. In former years collapsing thoracoplasties were performed in a large percentage of cases, probably at a moderate estimate in the neighborhood of 15 per cent. During the period covered by my table in all the cases operated upon in my service at Mt. Sinai Hospital, without the slightest attempt at selection, *there has not been a single thoracoplastic collapse operation.* There have been a number of revisions, secondary and even tertiary, but eventually all the patients referred to in the attached table not in the mortality list went home with symmetrical chests and fully expanded lungs. I believe that if nothing else had been accomplished by the work of the past three years this alone would entitle it to respectful consideration.

We have not taken unnecessary risk in selecting major thoracotomy as the method of choice. Whenever a patient's condition on admission to the Hospital was considered critical the relief of minor thoracotomy was given, and, in a few days to two or three weeks later, if it became

[4] This extraordinary mortality does not represent the dangers of Major Thoracotomy, for the reasons just given.

[5] Wilensky, Surg., Gyn. and Obst., May, 1915.

evident that something more had to be done, the radical operation was undertaken.

In the past two years one-third of our major thoracotomy cases were performed in two stages.

We try to avoid exploratory puncture of the thorax until just before the operation, depending on the clinical history, the physical signs, and above all, on the X-ray plate in making the provisional diagnosis.

Also, during convalescence, repeated observation with the aid of the X-ray, especially with stereoscopic plates, often determined the necessity for further operation. Indeed, no method surpasses röntgenography in deciding the form of treatment during the progress of the empyema; but röntgenography, valuable as it is, must be carefully checked up with the interpretation of the clinical phenomena.

X-ray examination has occasionally been the means of preventing operation when the needle has drawn pus from the chest.

CASE I.—A boy eleven, George W., was admitted with a history of pneumonia with continued fever long after the crisis should have occurred. The needle inserted by a physician not connected with the hospital had withdrawn pus and the case came to us for operation. The physical signs might have been taken for those of pyothorax, but the röntgenogram indicated consolidation (Fig. 1). In spite of the temperature of 104°, the cyanosis and distress, we delayed on the evidence of the X-ray alone, and we were rewarded by a well-marked crisis within 20 hours, the temperature reaching normal and convalescence proceeding uneventfully. The pus may have been a few drops of cellular fluid in the pleural sac or it may have been exudate from the lung itself.

CASE II.—A young woman, Bella G., with septic manifestations accompanied by tremendous oscillations of temperature, with pain and swelling of the larger articulations and with signs of fluid in the right chest, was seen by me in consultation. I was told that a few cubic centimetres of pus had been obtained by aspiration of the right chest. The X-ray picture made subsequently showed no evidence of fluid in the thorax and I advised against operation. A few days later I was informed that pus had been aspirated from the left chest as well. The patient was taken to the operating room and I withdrew about 2 c.c. of pus from the right side. The respiration, however, was not embarrassed as I thought it should have been in the presence of empyema in both thoracic cavities and I did not operate but ordered a second X-ray which, like the first, failed to show the expected opacity. At the present writing, three months after the first diagnosis of empyema, the thorax is perfectly clear, and the respirations are normal though the septic manifestations continue in spite of a general improvement.[6]

CASE III.—The patient, J. L., was a child of three, the son of a physician. He was referred to me by Dr. Koplik with the suspicion of empyema following pneumonia. The radiogram disclosed a shadow limited to the left lower lobe (Fig. 2), and on the strength

[6] July 25, 1917: This patient has completely recovered without operation.

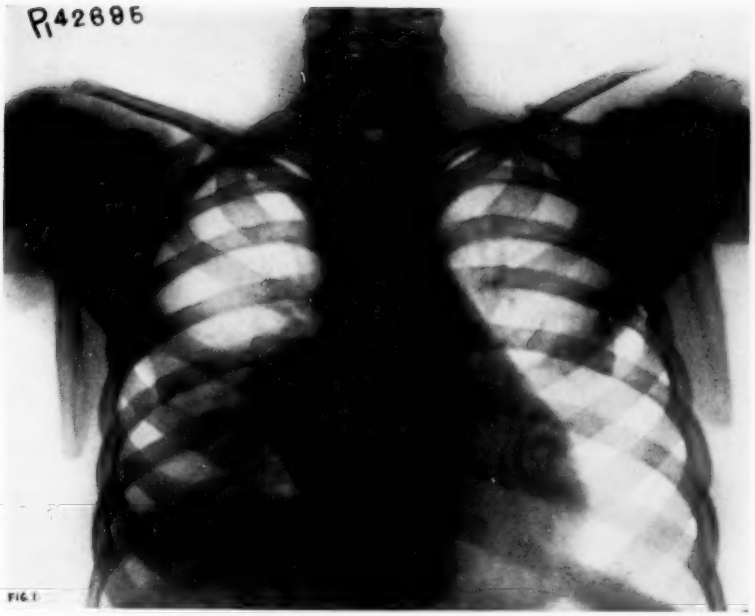

FIG. 1.—Case I, G. W., pneumonia, diagnosed as empyema and punctured for diagnosis by another physician. Note the small localized pneumothorax in the right lower chest, resulting from the admission of air probably through the needle. Patient recovered without operation.

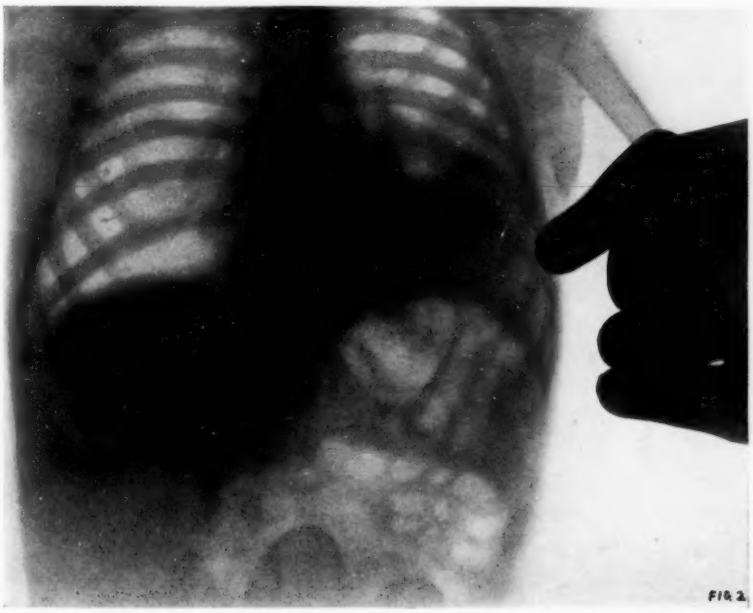

FIG. 2.—Left lower lobe suppurative pneumonia. No empyema was present, though the needle drew pus.

of this I deferred aspiration. A few days later, the septic temperature continuing and the child's father being importunate, I inserted a needle and withdrew a few drops of thick pus. The chest was then opened in local anæsthesia and the lower lobe found indurated, dusky in color and adherent to the chest wall, the free pleural cavity containing no fluid and appearing uninfected. Two abscesses, each containing about 5 c.c. of thick pus, were evacuated after being located in the lower pulmonary lobe with the needle through the wound and under the guidance of sight. The cavities were packed, the wound drained and the patient recovered. This case is by no means unique, though it is rare.

These three histories are here recorded not as cases of empyema but merely to illustrate methods of eliminative diagnosis.

There were three cases of double empyema. All the patients were critically ill and all were young male children. There were two recoveries and one death. The two patients who recovered were B. K., three and

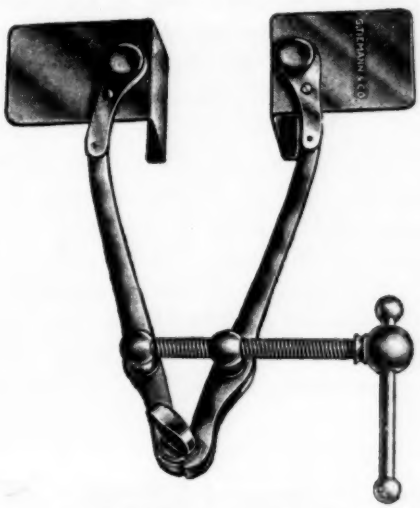

FIG. 3.—Author's rib spreading retractor. Two sets of blades.

one-third years old, and S. B., two and three-fourths years old. In one the chests were opened by minor thoracotomy two days apart and in the other by minor thoracotomy eighteen days apart. The fatal case was that of H. K., four and one-half years old. Here both chests were opened simultaneously on May 2, 1916. On June 13 it became necessary to resect the seventh and eighth ribs on the left side for drainage. He died septic four days later.

Minor thoracotomy in these young children is a mere puncture in local anæsthesia, often performed by inserting a trocar and cannula through a tiny skin incision, withdrawing the trocar and threading a tube through the cannula which being in turn removed leaves the tube draining the chest. The outer end is left long and with a suitable connection is led down beneath the surface of a weak lysol solution in a vessel beside the bed.

The operation of major thoracotomy has been fully described and illustrated[7] so repetition here is unnecessary. It is rarely accompanied by important bleeding and post-operative shock has thus far been easily combatted by means of morphine or codeine. We have had but one one death within twenty-four hours after the operation, an old man who was almost moribund at the time of the thoracotomy and who developed hemiplegia a few hours later.

The writer believes that many surgeons have been deterred from giving this method a trial because it requires a rib-spreading retractor, and during the past two and a half years it has been impossible to secure this instrument on account of the war. And it is true that without a powerful rib retractor the operation of intercostal major thoracotomy cannot be correctly done. As soon as it becomes necessary to make section of the ribs in order to gain the room for thorough exploration the operation increases in danger and the post-operative troubles multiply. Of all the foreign rib spreaders that of De Quervain is the simplest and the best, but even this well-made instrument is subject to annoying disorders of mechanism. Also, the blades are large for work in the case of children. The writer, therefore, has devised a simple retractor (Fig. 3) which is fully as powerful as any while its tendency to get out of order is reduced to the minimum. There are large and small blades which are interchangeable and the instrument can be quickly and easily taken apart. It is manufactured by Tiemann.

[After the reading of this paper the operation of major intercostal thoracotomy with lung mobilization was illustrated by a motion picture. This picture also showed the patient eleven days after operation. He was able to walk about and move his arms freely. Figs. 4, 5, and 6 are taken from this film by permission of the Clinical Film Co., Inc., who hold the copyright.]

	Minor thoracotomy		Major thoracotomy		Resection for encapsulated empyema		Resection and drainage, old method. (Minor thoracotomy)		Miscellaneous	
	Children	Adults	Children	Adults	Children	Adults	Children	Adults	Children	Adults
Number	31	7	21	23	6	1	6	1	0	4
Dead	6	1	4	8	0	0	1	0	0	3
Ages of those who died	⅓, 1½, 2, 3, 4, 4½	62	⅓, 2, 3½, 4	16, 24, 25, 35, 40, 43, 52, 55			1½			25, 27, 33
Per cent. mortality	19.3%	14.3%	19%	34.7%	0	0				
Total	38		44		7					
Mortality rate	18.4 per cent.		27.2 per cent.		0					

Total number of cases of empyema of all varieties which were operated upon primarily in Dr. Lilienthal's service in Mt. Sinai Hospital, March 25, 1914, to March 25, 1917, regardless of the source of the intrapleural pus	100	
Total number of deaths from whatever cause	23	
Percentage of mortality	23	per cent.
Children under 12 years	64	
Adults	36	

[7] See reference on page 291.

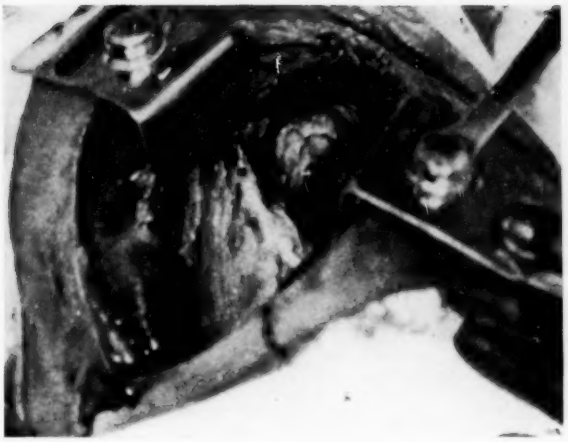

FIG. 4.—Rib spreader in place. The light colored mass in the lower left part of the incision is the contracted lower lobe covered by exudate. The mass in the depths toward the upper right part of the wound is the upper pulmonary lobe which is only a little contracted.

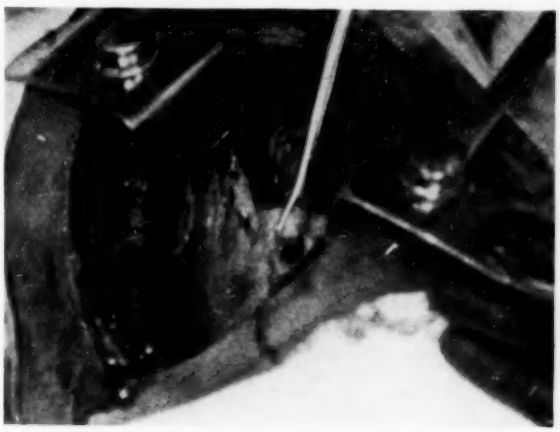

FIG. 5.—Removing lymph coagulum with forceps.

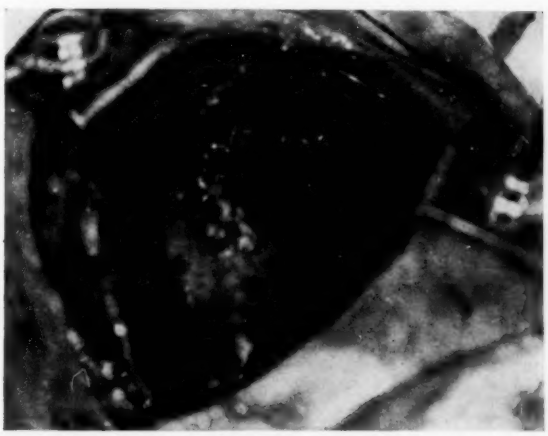

FIG. 6.—Note expansion of lower lobe by comparing with Figs. 4 and 5.

DILATATION OF THE HEART, WITH ACUTE MYOCARDITIS, FOLLOWING ABDOMINAL OPERATIONS*

By Edgar A. Vander Veer, M.D.
of Albany, N. Y.
attending surgeon, albany hospital

Not infrequently in consultation with fellow practitioners in medicine, and perhaps bearing upon some particular proposed operation, we are told of the "tobacco" heart—the heart carrying a high blood pressure, the heart associated with chronic alcoholism, the hypertrophied heart and the irritable or fatty heart—the heart believed to be undergoing fatty degeneration, and which may be attributed to some infective disease through which the patient has recently passed. Also we are told by the family physician, in the argument presented, that he had considered the case not a proper one for surgical intervention. Habits and environment may be brought into consideration. Conditions present in other organs of the body are discussed. Valvular lesions are so thoroughly understood as to be well recognized as factors of danger in surgical intervention. This clearness of diagnosis, however, teaches the surgeon the care to be exercised in his operative treatment. His favorable prognosis occasionally will bring under consideration one of the conditions that may be presented later, and of which I desire to speak; namely, myocardial conditions, or, as it is generally referred to, myocarditis and acute dilatation of the heart.

To have completed a successful operation, and when all is apparently going well with the patient, to be called, perhaps as soon as thirty-six hours or any time within two weeks, to the bedside of this surgical case, and to note the train of symptoms plainly found to be myocardial; that is, heart area greatly increased, rapid pulse-rate and intermittent; apex beat weak, diffused, patient restless and presenting an unexplained state of anxiety; does not complain of any acute pain—with these conditions one is brought into that intense atmosphere of anxiety, of which our older surgeons used to speak in connection with immediate or secondary post-operative hemorrhage. But much more helpless are we surgeons of to-day. Referring especially to abdominal surgery, the success of to-day is so great that when we meet a sudden, unexpected death, it becomes our duty to study even more carefully the causes producing such a result.

Are there in some cases foci of infection resulting from the operation which are aroused to activity and attack the heart muscle as a line of preference?

My wish in this short paper is to report a few cases very distressing to me in my surgical work. A series of abdominal operations occurring in my service at the Albany Hospital, which were followed by acute myocarditis, first attracted my attention to this coincidence. Since then I have

* Read before the American Surgical Association, June 2, 1917.

observed that in gall-bladder or appendix infection which has existed for any length of time, even though no apparent heart symptoms appeared before operation, they did in a certain percentage appear soon after in a greater or lesser degree. I have not observed this phenomenon following other abdominal operations, but I see no reason why it might not occur.

In Billings' work on Focal Infections, he quotes some experiments conducted by Dr. Rosenow, in which the relation of certain strains of bacteria found in the gall-bladder produced an acute myocarditis when these bacteria were injected into an animal. Outside of the reports of these experiments, and a paper by Dr. Robert H. Babcock, of Chicago, published in the *Journal of the American Medical Association*, of July 12, 1909, and later in the *Southern California Practitioner* for March, 1911, entitled "The Effects of Chronic Cholecystitis on the Heart," I have been unable to find anything in the literature upon the subject, and absolutely nothing from a surgical standpoint. In his paper, Dr. Babcock cites a series of myocarditis which were associated with chronic gall-bladder disease, and which were greatly benefited by operation upon the gall-bladder.

I append here a few histories in which operation upon the gall-bladder or appendix was followed by symptoms of acute myocarditis and acute dilatation of the heart.

CASE I.—J. G., age sixty-four, lawyer, always in good health, operated upon for an acute gangrenous appendix, symptoms extending over a period of forty-eight hours. Before operation systolic blood pressure was 160 mm., diastolic 110 mm. Pulse full and regular, sixty to the minute. Anæsthesia and operation uneventful. No unfavorable symptoms for the first sixty hours after operation; then gradual increase in pulse-rate, from sixty to 110, respirations twenty-four per minute, heart sounds rather distant—many of the clinical symptoms of an acute myocarditis. Treatment consisted of low enemas and the administration of digitalin. Patient gradually recovered, the wound healed promptly, showing no signs of any infection whatever. Three months after the operation, heart had returned to its normal condition, and pulse regular. Complete convalescence established.

CASE II.—Mrs. S., age fifty-three, widow, housewife. History of gall-bladder trouble for several years. Operation for chlolelithiasis, several gall-stones removed. Anæsthesia well borne, and field of operation did not present any unusual complications. For the first thirty hours no unfavorable conditions, then all the symptoms of acute myocarditis developed, and the patient died twelve hours later. This patient presented a severe example of mental depression, saying that she did not believe she would recover from an operation. Such a result is most distressing to the operator and to the friends. In cases of malignancy, and where we have serious lesions with which to deal, we are prepared somewhat for a percentage of mortality, but an unexpected death is not easily forgotten. Unfortunately, such a result militates against securing an autopsy, this being the case here; her friends were overwhelmed by the result.

CASE III.—Mrs. A. A., age sixty-six, married, housewife. History of gall-bladder trouble extending over several years. Operation for cholelithiasis and cholecystitis. Anæsthetic presented no unpleasant complications, and operation completed without embarrassment. Gall-stones removed and gall-bladder drained. Heart action normal. Patient progressed nicely for first fifty hours, when symptoms of acute myocarditis with dilatation of the heart presented. Slow and rather stormy convalescence.

CASE IV.—Mrs. P. B., age sixty-two, married, housewife. Operation for chronic cholecystitis and cholelithiasis and acute appendicitis. No complications. Ether and operation uneventful. Heart normal. Case progressed normally for sixty-five hours, when quite unexpectedly dilatation of the heart, with symptoms of acute myocarditis, appeared. Prolonged convalescence.

CASE V.—J. M., age sixty-two, blacksmith. No clinical evidence of myocardial trouble. Operation for cholelithiasis. Etherization and operation well borne. Case progressed favorably for twenty hours, when symptoms of acute myocarditis, with dilatation, presented. Patient responded rather tardily to treatment, but finally recovered.

CASE VI.—Mrs. R. M., age sixty-four, widow, housewife. Typical symptoms of cholecystitis extending over a period of years. Physical examination, heart and lungs normal. Operation: draining of the gall-bladder and appendectomy. Did nicely for fifty-five hours, when symptoms of acute myocarditis intervened, and convalescence was greatly prolonged.

An analysis of these cases presents the fact that physical examination of the heart before operation revealed no symptoms of myocardial trouble. Etherization in every case was without unfavorable symptoms. All recovered from the immediate shock of the operation and were well on their way to recovery when the symptoms of acute myocarditis appeared. None of the cases gave a history of any heart lesion. None of the wounds, blood examination, or symptoms gave any indication of septic infection. Apparently the operation excited germs which were in the gall-bladder or appendix, and they secondarily invaded the heart muscle, in keeping with the views expressed by Rosenow.

With one exception, all these cases were elderly and had suffered several years with gall-bladder disease, so that it is very possible this condition of acute myocarditis might have been the result of the long period of suffering augmented by the shock of the operation. However, in cases of other abdominal conditions I have not observed this post-operative complication so marked. Therefore, is it reasonable to assume that the acute myocardial symptoms in these cases were due to a secondary infection?

Pathological study of these cases, as presented in the laboratory reports, is interesting. In these, as well as others, we have brought to our attention many etiological factors only recently understood, and all emphasizing the benefit resulting from the laboratory research work. I am of the impression, particularly in our cases of appendix and gall-bladder operations, that

a careful and thorough examination of the secretions should be made promptly after operation, and a record preserved, to be of aid in treatment should symptoms of myocardial involvement present.

In these cases of cholecystitis the gall-bladder was drained only. What the effect might have been if a cholecystectomy had been done I, of course, cannot say with any degree of certainty, and it involves the question of cholecystectomy versus cholecystotomy. In a few other cases, not here reported, where the appendix was removed, acute myocarditis followed in like manner.

Would it not be advisable to develop a stock vaccine or antitoxin from the gall-bladder or other abdominal organs involved, and use it in cases of this sort? At the present time I am outlining a series of experiments to be conducted at the Bender Hygienic Laboratory, along these lines, with the view of developing a vaccine or antitoxin for this distressing complication. When we feel quite sure that acute symptoms are liable to follow surgical intervention, possibly we might vaccinate the patient before operation. This would be in elderly cases with long-standing gall-bladder or appendix conditions.

As mentioned above, in Billings' work on Focal Infections, he speaks of a strain of streptococci, isolated by Rosenow, which inhabit the gall-bladder and secondarily cause acute myocarditis; also of strains of streptococci in other organs and tissues of the body. Therefore, why is it not probable, in these chronic gall-bladder and appendix cases, that doing an operation excites these peculiar colonies of streptococci, starts them on their journey and causes acute myocarditis? We all know that the diseased tonsil is occasionally followed by acute secondary infections in other parts of the body. So in the same way operations upon the diseased gall-bladder and appendix, when the right strain of bacteria is encountered, cause acute myocarditis. Just how this condition can be recognized and prophylactic measures adopted, I am unable to say. Undoubtedly, cultures from the bile might be made in every case of cholecystitis, appendicitis or other abdominal disease, and held in case any myocardial symptoms appear.

My impression is that acute myocarditis following abdominal operation occurs oftener than commonly supposed, and should always be watched for. Is it probably due to streptococci lying in the gall-bladder or appendix, with a selective affinity for the heart muscle, as described by Rosenow?

In considering these few cases to which I have referred, there being one death—postmortem not allowed—it has occurred to me that I might gather some additional facts in looking over the records of the following autopsies, secured at the Bender Laboratory, which have a direct bearing upon the relations between the condition of the gall-bladder found and that of the heart.

In the study of these eight autopsies, bearing directly upon the gall-bladder conditions, without operation, made at the Albany Hospital and elsewhere, during five years, the following conditions are to be noticed:

There were five males, three females, ages 70, 72, 62, 56, 60, 47 and 42 (one age or condition not stated). Jaundice present in six cases.

CASE I.—Male, age seventy, acute and chronic cholecystitis. Gall-bladder distended, adherent and contained thick yellowish-brown fluid, twenty-one gall-stones. Heart 320 grams; otherwise negative in gross appearance. Microscopic examination not completed. It will be observed that the heart in weight was above normal. Cause of death recorded, chronic cholecystitis.

CASE II.—Adult, female, bronchial pneumonia, and of which she died. Gall-bladder wall greatly thickened; two large masses resembling burrs found. Cystic duct entirely occluded. Heart: right markedly dilated, myocardium brownish in color.

CASE III.—Female, age seventy-two, jaundice. Gall-bladder small, many adhesions, two large round stones. Heart 220 grams, muscle flabby, dilated right heart. Microscopic: fibrous myocarditis. Cause of death, carcinoma of the liver.

CASE IV.—Male, age sixty-two, jaundice. Patient died within few hours after entering the hospital. There was found acute cholecystitis, with perforation, fifty facetted calculi. Acute general peritonitis. Heart normal. Cause of death, general peritonitis.

CASE V.—Female, age fifty-six, jaundice, died of pulmonary œdema. Gall-bladder very adherent, small, many small gall-stones, one in hepatic duct. Œdema of the lungs very pronounced. Heart walls collapsed; musculature brownish color, soft and flabby. Microscopic: Apparent œdema, few lymphocytes scattered about. Cause of death, œdema of the lungs.

CASE VI.—Male, age sixty, gall-bladder small, adherent, several facetted gall-stones. Heart dilated, mitral and aortic thickening, with calcification, coronaries slightly sclerosed, weight 450 grams. Cause of death, acute dilatation of the heart.

CASE VII.—Male, age forty-seven. Gall-bladder thickened, filled with muco-purulent material, many stones present; ducts obstructed, acute hepatitis. Heart cavities normal, musculature flabby; coronaries negative. Microscopic: Chronic fibrous myocarditis, subacute pericarditis. Cause of death, subacute myocarditis.

CASE VIII.—Male, age forty-two, jaundice. Gall-bladder distended with bile, ulcerated; acute and chronic hepatitis. Heart, both sides flabby, muscle soft and pale; increased fibrous tissue, numerous leucocytes, few plasma cells and polynuclear leucocytes. Microscopic: acute and chronic myocarditis. Cause of death, subacute myocarditis.

While these cases may be of little value, I feel somewhat hopeful that something to aid in our future early recognition of acute dilatation may develop and operative surgery meet with less of the few remaining defeats that may be our lot to come in contact with. They also carry out the conclusions so well expressed by Dr. Wm. J. Mayo, that gall-stones may be considered foreign bodies, and, other things being equal, the earlier these foreign bodies are removed the better for the patient.

EPIGASTRIC HERNIA WITHOUT PALPABLE SWELLING*

By Alexis V. Moschcowitz, M.D.
of New York City
ATTENDING SURGEON, MT. SINAI HOSPITAL; PROFESSOR OF CLINICAL SURGERY, COLLEGE OF PHYSICIANS AND SURGEONS, COLUMBIA UNIVERSITY

In a previous communication upon the subject entitled "The Pathogenesis of Hernia of the Linea Alba," I believe I have proven quite conclusively that in by far the largest number of these herniæ the condition is not a hernia in the true sense of the word. From time immemorial the term "hernia" has come to mean a protrusion of a peritoneal sac. This is so generally acknowledged that we look upon the presence of a hernial sac as an essential requirement of all herniæ. In epigastric hernia, however, a peritoneal sac is of exceptional rarity; I have not examined my statistics regarding this point, but I am safe in stating that not more than one case in twenty has a true hernial sac. Even in the cases which do have a hernial sac, the sac is only a secondary acquisition, and is found only after the hernia has attained a sufficient magnitude to pull out a peritoneal diverticulum. In the paper already quoted I have also demonstrated that in most of the cases the bulk of the protruded mass is not, as is commonly assumed, composed of omentum, but is merely a prolongation of the fat enclosed between the two peritoneal layers forming the falciform ligament of the liver. The commonest form of epigastric hernia is sacless, and one in which the peritoneum is not involved in the least.

Epigastric hernia differs from all other herniæ also in a further important attribute, namely, that it has a very distinct symptom complex. By far the greatest majority of uncomplicated herniæ in other parts of the body are symptomless. On the other hand, I have found the symptomatology of epigastric hernia to be so constant that its absence in a doubtful case would be sufficient to exclude the diagnosis of such a hernia. It is true that the symptoms of an epigastric hernia are little known and quite vague; still they are fairly characteristic. The patients usually complain of eructations, nausea, and periodic attacks of pain, which they localize into the entire epigastrium. These complaints are not unlike those we are accustomed to see in ulcers of the stomach or duodunum, with the difference, however, that they do not bear such a constant relation to the ingestion of food. I do not intend to discuss in detail the differential diagnosis between epigastric hernia and gastric ulcer. I merely wish to point out that the symptomatology of an epigastric hernia, no matter how large, or how small, has a striking similarity to that of a gastric ulcer.

As for the physical examination we find in epigastric hernia first of all a mass situated at or near the median line of the abdomen, some place between the umbilicus and the xiphoid appendix. The smaller herniæ

* Read before the American Surgical Association, June 1, 1917.

appear to be situated directly in the median line; in their subsequent growth, however, they usually extend away from the median line, usually towards the left side.

The hernial protrusion varies greatly in size; in the majority of the cases the mass is very small, rarely larger than a marble. In some cases the hernia is very small, sometimes not larger than a pea or a lentil, in consequence of which, and more particularly in the obese, it is very difficult to palpate. Occasionally all that is discoverable, either on inspection or upon the gentlest palpation, is a very slight elevation in the midline of the abdomen. I have found that the best way to practice inspection in these small herniæ is to stand at the head of the patient, and then to examine the linea in not too brilliant illumination so as to note the slightest differences. The palpation in these cases is best practiced with the aid of a single finger.

Irreducibility of the mass is a very frequent characteristic of epigastric hernia.

I am now coming to an unappreciated and yet absolutely constant physical sign of epigastric hernia; namely, that no matter what the symptoms caused by the hernia; no matter what the size of the hernia; no matter whether reducible or not; no matter whether the patient is of the phlegmatic or hysterical type, the hernial protrusion itself, and more particularly the ring or opening through which it makes its escape into the subcutaneous tissues is always very tender. This is so characteristic that in the very smallest herniæ; *i.e.*, those which cannot be palpated with an absolute certainty, the diagnosis of an epigastric hernia can and should be made by finding such an extremely tender point in the midline of the abdomen. All cases giving a history resembling vaguely that of a gastric ulcer should be examined for a small epigastric hernia; this examination is materially aided by finding a tender point in the midline of the abdomen. Difficulty arises only in such cases in which there appears to be a combination of the two maladies, namely, an epigastric hernia complicated with a gastric ulcer; but even in these a differential diagnosis ought to be made with comparative ease. The tenderness in gastric ulcer is not as superficial nor as sharply circumscribed as in epigastric herniæ. The cause of the pain in cases of epigastric hernia is still a moot point. The early writers upon the subject (Garengeot, Pipelet, etc.), were of the opinion that the gastric distress complained of by these patients was due to the fact that the stomach formed the most frequent hernial content. Subsequently writers accepted this statement of Garengeot tacitly. Only within comparatively recent years was the frequently assumed presence of the stomach as a hernial content disproven. I believe that the pain is merely a referred pain, and is caused by a dragging upon the falciform ligament of the liver.

As far as I know the tenderness in the protruded fat and also in the hernial ring has never before been described. As already stated I have not failed to find it in a single instance; it is very surprising to me that it should have escaped attention till now. It is such a constant symptom that

its explanation ought to be apparently very easy. Unfortunately it is not, and I confess that thus far I am still undecided as to the reasons for the tenderness. There are several possibilities. I am now investigating this point, but my investigations are not yet sufficiently advanced to permit me to speak authoritatively. When these investigations have been completed I shall be glad to report upon them.

In view of the uncertainties regarding the causative factor of the pain and of the tenderness in epigastric hernia I wish to call attention to a symptom complex resembling that of the commonly accepted epigastric hernia in every respect, and yet there was not even an indication of a hernia present.

My observations are based upon two cases only. I shall therefore give their histories with some detail. Both cases were referred to me by Dr. Seymour Basch, and I avail myself of this opportunity to express my appreciation for the careful preoperative observation and the notes of the cases.

CASE I.—Mrs. M. M., thirty years of age. Patient was operated upon three years ago for a chronic appendicitis, after two attacks of a rather acute character. At the operation many adhesions of the omentum were found. Previous to the operation the patient suffered also from frequent attacks of nausea, which she relieved by inducing vomiting. Since five years the patient also complains of peculiar attacks of sneezing, which occur irrespective of time and place; on awaking in the morning she would sneeze a number of times in succession, followed by a discharge of a watery fluid from the nose, however without the sensation of nasal obstruction. Patient has had all kinds of local and general treatment, but entirely without any success.

Extirpation of the appendix had no influence whatsoever upon her previous complaints. The nausea and vomiting promptly recurred. Patient married shortly after operation. During the first six months of the ensuing pregnancy patient vomited so much that she was unable to retain anything. In spite of this, however, she felt too well to remain in bed for any length of time.

Patient is decidedly of the phlegmatic type. Skin and mucous membranes rather pale. Examination of the heart, lungs, and central nervous system is negative. The urine shows no abnormalities. No goitre is present, and there are no enlarged lymphatic glands. The abdomen was slightly pendulous. The right kidney is slightly ptosed, the greater curvature of the stomach appears to be at the level of the umbilicus. One and one-half inches above the umbilicus, in the linea alba, there is a small and persistent point of tenderness; patient winces with pain when pressure is exerted upon this point; this point is localizable with an absolute precision; it was also impossible to elicit another similar point throughout the entire abdominal examination. Not even the slightest indication of a mass, such as a small epigastric hernia would give, is to be felt. This point of tenderness and its exact location and invariability were verified upon a number of subsequent occasions.

Examination of the stomach contents one hour after an Ewald test breakfast showed 58 total acidity, and 36 free HCl; no gross or microscopical abnormalities. The thread test was negative. X-ray examination of the stomach and intestines was also negative.

Had a physical examination of this patient revealed even the slightest indication of a swelling at the point of tenderness in the midline of the abdomen, its presence taken in conjunction with the history would have induced me to make the diagnosis of an epigastric hernia without the slightest hesitation. In the absence of such a swelling, however, I refrained from making any diagnosis at first. On subsequent examinations I finally decided to operate, upon the presumptive diagnosis that an impalpable hernia existed.

Operation, March 17, 1915. The dissection was carried out with the greatest care, in order not to destroy the evidence of our findings. One and one-half inches above the umbilicus, in the linea alba, exactly at the point of the persistent tenderness, there was encountered a good sized vessel surrounded by a delicate fascia, which escaped through a transverse elliptical opening in the linea alba. No trace of a fat protrusion was seen. The vessel was ligated, and the part distal to the ligature cut away. The proximal stump was pushed back into the hole, and the latter closed with one Pagenstecher suture. Patient made an uneventful recovery.

Under date of January 1, 1917, I heard from Dr. S. Basch, that her recovery was startlingly rapid, and the result persistently good. Patient lives out of town, but reports to me from time to time. She has gone through another pregnancy since the operation, and absolutely without any trouble.

CASE II.—Miss D. J. R., twenty years of age, single, was also referred to me by Dr. Basch. At the age of five months, patient had whooping cough, which lasted an entire year, and was accompanied by a great deal of retching and vomiting. Four years ago, patient was operated upon in a neighboring city for appendicitis. Patient suffers from habitual constipation for practically her entire life, in consequence of which she is compelled to continually take laxatives.

For many years patient has been suffering from recurring attacks of nausea in the morning, which usually occur on arising and disappear spontaneously in the course of the forenoon; occasionally the nausea is so severe that patient also vomits. These attacks of nausea are increasing in frequency, so that hardly a day passes by without an attack. They were absent for a very short while only after the operation for appendicitis.

Physical examination is negative except for the following:

There is a definite circumscribed point of tenderness in the linea alba, two and one-half inches above the umbilicus. This point of tenderness is found upon repeated examinations and at various intervals. No other point of tenderness is elicited anywhere upon the abdomen.

Examination of the stomach contents one hour after an Ewald-Boas test meal showed a total acidity of 72, and free HCl 42; microscopical examination was negative.

She was treated at first symptomatically with appropriate diet, rest, and abdominal bandage, and the internal administration of validol, however without relief.

In the absence of any definite physical signs I was at first averse to suggest an operation. But having in mind the excellent results obtained in the practically similar Case 1, I suggested the consideration of an operation. This was carried out July 24, 1916. The linea alba was exposed through the longitudinal incision, and at the point exactly two and one-half inches above the umbilicus a vessel was seen emerging from the linea alba, through a small transverely oval opening. The vessel was ligated between two ligatures, the proximal stump pushed back and the opening closed.

After operation patient at first perfectly well, again suffering from time to time with nausea, but finally this disappeared completely, and now, ten months after operation, she feels perfectly well.

To recapitulate in brief the salient points of these two cases they were the following:

1. The symptoms were remotely suggestive of those of an ulcer of the stomach, and therefore also those of the well-observed cases of epigastric hernia.

2. The principal physical sign was a localized area of tenderness, of the size of a lead pencil, in the middle of the abdomen, between the umbilicus and the xiphoid appendix.

3. The complete absence of a true hernia of the linea alba; and also the absence of the merest indication of one, as might be represented by a small lipomatous outgrowth contiguous with the fat contained in the falciform ligament of the liver.

4. The sole finding at the operation was the blood-vessel normally present, which pierced the linea alba exactly at the previously outlined area of tenderness. The opening in the linea alba was perhaps larger than is normal.

5. A cure and complete relief of all symptoms by simple ligation of the vessel, pushing back of the proximal stump, and closure of the opening.

I have searched the literature most carefully, but I have failed to find a single similar case. Singularly, however, I found an article by Mohr,[2] with practically the same title as I have given to this article, namely, "Uber Hernia Epigastrica ohne fühlbare Geschwulst," in which the author gives a short history of two cases which he had observed; he also quotes other authors as having seen similar cases.

MOHR'S cases are immensely interesting. I will be pardoned, therefore, if I abstract same.

CASE I.—Male, forty years of age, who had been suffering for years with digestive disturbances; namely, irregular, occasionally extremely severe, coliclike attacks of pain in the upper abdomen. He was treated for a very long time by internal medication, and about two years before coming into Mohr's care had been operated upon by another surgeon, he was told, for a median (epigastric?)

hernia; the operation, however, brought the patient no relief from the symptoms, which returned promptly after patient left his bed. Fifteen months later patient was again operated upon by another surgeon, for the cure of a ventral hernia in the cicatrix of the previous operation. After this operation the attacks disappeared for six weeks, but then recurred in their old severity. Mohr saw the patient eight months after the second operation, and at his examination found that the patient was greatly emaciated and apparently suffering greatly. In the linea alba above the umbilicus there is to be seen a well-healed cicatrix of the previous operation, without any trace of a ventral hernia. Two fingers' breadth above the upper end of the incision, and exactly in the midline of the abdomen, there is a sharply circumscribed localized point of tenderness, which is so small that it can be covered by the tip of a finger; everything else is negative. On repeated examinations this point of tenderness was never found to vary; the vicinity of this point and the cicatrix of the previous operation were not in the least tender. Patient insists that his pains originate in this tender point. He was operated upon by Mohr, who found, behind the old cicatrix, extensive adhesions between it and the linea alba, colon and omentum. Above the cicatrix the parietal peritoneum was free from adhesions, only a long drawn-out piece of omentum was adherent between the stomach and the tender point; a hernia sensu strictu was not present. The adherent tip of omentum was ligated and liberated. Primary union. Patient was absolutely free from pain from the date of operation, and this freedom continued up to the time of publication (five months).

Epicrisis. It is perfectly possible that Mohr dealt with just such a case as I have reported; but judging merely by his description one must naturally arrive at the conclusion that the case is by no means proven. It is true that no hernia was seen; in fact, nothing was seen that would remind one even remotely of one; all that was seen was a mass of adhesions, originating from the two previous operations, and a bit of omentum adherent in the midline of the abdomen, all of which may be sufficient to explain the symptoms, but is not sufficient to entitle an author to publish the case as one of epigastric hernia without any palpable tumor.

Case II was also a male, thirty-four years of age, with an anamnesis and symptoms similar to Case I. Physical examination showed exactly in the midline of the abdomen, three fingers' breadth above the umbilicus, a constant, sharply circumscribed point of tenderness. Patient suffered so much that an exploratory operation was advised. Incision of the abdominal wall down to the tranversalis fascia failed to show signs of a hernia; only when this fascia was incised, at the previously described point of tenderness, a lump of fatty tissue popped out. As this was pulled open the peritoneum tore, and it was then seen that the fat was the end of a bit of omentum, which ran to the stomach, and the free end of which escaped through the hiatus in the linea alba and then became incarcerated. This portion of the omentum was ligated and replaced into the abdomen. Patient is free from pain since the operation. A few months later he again suffered from an attack of abdominal colic, but Mohr believes that it had nothing to do with his previous operations. At the time of publication (four years) patient is still free from all trouble.

Epicrisis. The case is not absolutely acceptable as one of epigastric hernia without palpable swelling, for the following reasons: The description is not quite clear. That fat protruded when the transversalis fascia opposite the tender point was incised is no criterion, because this is found

to occur wherever the falciform ligament is attached. Furthermore the case was complicated by an intra-abdominal pathological condition, which in itself may have been the cause of the symptoms and not the hernia.

Mohr quotes from the literature, so to say, in fortification of his standpoint, other cases, which on analysis, however, are not bona fide cases of epigastric hernia without palpable swelling.

Kuttner [3] gives an excellent résumé of the subject of epigastric hernia, particularly as it bears upon the gastric symptoms. He also emphasizes the fact that even sacless epigastric herniæ, *i.e.*, such composed only of a subserous lipoma, give similar symptoms, but he does not mention epigastric herniæ without any swelling. His smallest case was evidently the size of a lentil, but even this was palpated perfectly before operation.

Mohr next quotes Liniger,[4] but this author reports no case as belonging into this group; he merely says that occasionally the smallest epigastric herniæ give rise to the severest symptoms. Thus one hernia, the size of a pea, gave rise to such severe symptoms that patient was prevented from taking sufficient nourishment.

> Temoin [5] records a most interesting case of vomiting which had existed for over one year, and which defied all internal medication. Absolutely nothing was found on examination, as far as inspection and palpation were concerned, except a point of extreme tenderness between the umbilicus and xiphoid appendix, pressure upon which brought on an attack of vomiting. Temoin advised an operation, and on very careful dissection he found in the median line a small omental hernia, which was twice as large as the head of a pin, and which it was naturally impossible to discover by palpation. It had no sac, and was directly contiguous with the omentum (?). Resection and closing of the wound were followed by complete recovery.

Epicrisis. This case is perhaps nearer than any other one to my cases. The hernia was certainly very small, exceedingly small, but still fat was present, a fact which differentiates it from my cases. I do not wish to speak of the other erroneous observations of the case, such as continuation with the omentum.

Wittgenstein and Grosse [6] give an excellent résumé of the subject, but quote no case.

> Metzger [7] reports a case which is so interesting that a verbatim translation is justified. The patient was a male, forty years of age, who complained of pain in the stomach, and in whom a hyperacidity was found. Metzger found in the linea alba above the umbilicus a very tender point, and as no benefit whatsoever was obtained from medicinal and dietetic treatment, he referred the patient to the surgical clinic in Tübingen for operation; no hernia was found; nevertheless patient was completely cured by the operation.
>
> Metzger says that most probably the case was one of those small slit-like openings in the fascia, which was cured by the suturing of the divided fascia.

Epicrisis. This case resembles in many details the two reported by me. It is regrettable, however, that the author did not operate the case in person, and that the report is therefore second hand, so to speak.

It is perfectly possible that the observations I have made in the two cases I reported are well known, and therefore hardly worth while placing on record. However, I have, as already stated, failed to find any reference whatsoever to such cases in the literature. Mohr's cases can hardly be said to be true cases of epigastric hernia without palpable swelling, because they were complicated by intraperitoneal adhesions, etc. The cases he refers to, to fortify his stand, were at best very small hernia.

The choice of the title of this article, "Epigastric Hernia Without Palpable Swelling," is not entirely satisfactory to me, because I have not brought forward any valid proof that the symptoms in these cases were due to an epigastric hernia. There are to my mind only three possibilities to explain the symptoms and their relief by operation. The fat protrusion may have been so small as to escape attention. I do not believe this, because both cases were operated upon with the most punctilious care, in order not to destroy any evidence of a protrusion. It is reasonably possible, that the fat protrusion may have been present, but that it was absent during the operation, while the patient was anæsthetised; this does not appear to me to be probable, because I believe that the protrusion would have become evident in the course of the operation. I purposely pulled upon the vessel to render any temporarily reduced fat protrusion visible, but I failed to do so. A third possibility is that it was an epigastric hernia, in which the fat protrusion had not yet escaped beyond the linea alba; that is, that it was, so to say, an interstitial form of an epigastric hernia. I look upon this explanation as very probably the true one, and I base my opinion upon the following facts. First, the symptomatology which is absolutely identical with that of a complete epigastric hernia; second, upon the identical pathology; and finally also upon the perfect cure, which ensued upon simple ligation and division of the vessel, and closure of the opening through which it escaped.

I believe the subject is of some importance, particularly on account of its close resemblance to gastric ulcer. I hope my observations will be verified.

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PARAFFINE HERNIA*

HERNIA COMPLICATED BY PARAFFINE INJECTIONS

By August Frederick Jonas, M.D.
of Omaha, Nebraska

The title for this communication is open to criticism, for it does not strictly comply with the usual definition of hernia. If we insist that only those defects which consist of "a protrusion of any viscus through an adventitious opening in the wall of the cavity which contains it," we can hardly reconcile it with the designation of paraffine hernia. For it has been shown that only occasionally is injected paraffine found within the hernial sac and then it does not protrude through an adventitious opening and it is not a part of the anatomy of the carrier. It has found its lodgment from without and not from within and is an extraneous foreign substance. But we will use the term for our convenience to describe a series of cases where paraffine was used with the intent to cure hernia. These findings have been described inaccurately as paraffinoma. We really have hernias complicated by paraffine.

Since Gersuny introduced paraffine for prosthetic purposes, the method has been employed for a series of widely differing surgical defects. Undulating nasal backs, sunken cicatrices claimed the early attention of operators; later followed efforts to maintain prolapsed uteri and descended rectal termini, and urinary incontinence was said to be controlled by it. Cleft palate received due attention, facial blemishes that were existant and those that still remained in expectancy became the monopoly of the beauty doctor. In the course of time the herniologist, after he had found wanting and had discarded the local injection of alcohol, tannic acid solution, chloride of zinc and many other curatives, and the application of his inefficient but marvelously constructed trusses that were credited with magical power had failed, pounced upon paraffine as the all-saving and never-failing cure-all for hernias of all descriptions. Gersuny had informed the surgical world that paraffine when injected subcutaneously set at once, and it became a smooth, easily moulded, unchanging, painless, and unirritating support. It was not long before some fertile-minded genius bethought himself of making a stopper for the inguinal canal to prevent the spilling of an intestinal coil and he believed it could be modelled into any shape that the requirements of the operator suggested. Our specialist then claimed the field for his endeavors, and when he announced himself as prepared successfully to do this work without knife or pain and no detention from business, he certainly had come into his own, for he still flourishes beyond all measure. His few

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devotees extol his achievements and his many dupes are eloquent in their silence. His promising advertisements still maintain a long waiting list.

It may interest us to consider some personal observations on the end results of a few personally observed cases of hernia that had subjected themselves to paraffine injections.

It has been the writer's privilege to have operated and removed the paraffine in ten of these cases, in all of whom the hernia still persisted. All of them applied for treatment because the hernia continued to be uncured, and in every one the pain and discomfort had become continually more severe and in several instances unbearable.

It seems that the object aimed at in the paraffine injection method is to create a plug in or at the inguinal canal which is designed to create a stopper or cork to retain the hernial loop in its normal location, very much like the cork in a bottle. Theoretically such expectation might, in a measure, be expected if the cork were always accurately applied and filled the inguinal canal completely from external to internal ring, preventing the descent of an intestinal loop into any part of the canal. It is not clear whether the intention has been to inject the paraffine into the hernial sac, filling that portion constituting its neck, or whether the paraffine is to be introduced external to the sac to compress its neck so as to prevent an intestinal descent.

Whatever may have been the intent of the originators of the procedure, the practical workings have been uncertain. The widely differing relations of the injected paraffine to the inguinal canal, as shown by the cases here reported, indicate either the impossibility of an accurate control of the injection or an ignorance of anatomy of the inguinal canal and the nature of hernia on the part of the operator, or both.

When one takes into account the impossibility of ascertaining clinically the exact size of the hernial sac, whether it can be pushed back with the reduced hernial loop or whether it extends partly or completely into the scrotum, or whether there exist omental adhesions, whether the sac wall is thin or thick, whether the canal is long or short and in some cases whether hernia is direct or indirect, it becomes clear that no matter how accurate the knowledge of anatomy or however skilful may be the planting of the paraffine, the method must be inaccurate and if successful in placing the injected mass so that it will hold the hernia, is as much of an accident as its promiscuous distribution in, around and beyond the actual defects as found in the average case.

When we recall the endless varying conditions found at an open operation and the impossibility of determining in advance of an exposure of the parts the altered anatomical landmarks, it becomes clear that any treatment that is administered by the subcutaneous method lacks all essential of accuracy and its technical uncertainties should condemn it.

In all of the cases to be herein detailed there were no two cases in which the paraffine occupied the same anatomical structures, nor was there any uniformity as to the quantity deposited. In the greater number of cases

the injected material was found outside of the hernial sac and the inguinal canal. In one case the paraffine mass was larger than an ordinary fist and it extended from the pubic tuberculum to the anterior iliac spine. In another it was deposited in several masses about but outside of the external ring and extending down along the descending pubic ramus of the urethra. In one instance the hernial sac was almost filled with a mass the size of a hen's egg; it extended nearly to the internal ring like a cork; but it was not sufficient to retain the hernia—a hernial loop had slipped down beside it. In another case the paraffine was so small in amount that only a small, flat, fibrous nodule, outside of and attached to the cord, remained.

In a number of cases several injections had been made at different sittings, as many as seven injections in one case, because the hernia recurred after each treatment. In several instances the paraffine was found outward to and above and in several below the inguinal canal without effect for better or worse in the defect except to produce pain which had not existed before.

We naturally ask ourselves, What becomes of the injected paraffine? Gersuny and others insisted that it remained unchanged in the tissue. That is apparently true in many instances, but not invariably so. In referring to our own cases, several masses that had been injected into the loose areolar tissues in the groin, and particularly in obese subjects, the masses were round and had smooth surfaces; they were easily shelled out; there were absolutely no connective tissue attachments. The cavities, from which the nodules were removed, were smooth. No attempts had been made to create limiting membranes of connective tissue. In the older cases, where the masses had been made more than two years previously, the limiting membranes were distinct. In one case two distinct masses of paraffine, one anterior and one posterior to the cord, had been injected eight years previously and remained unchanged.

The masses found within the hernial sac were unchanged. There was no noticeable change in the endothelial lining of the sac except at the point where the needle had entered; at that point there was a distinct fibrous attachment, its fibres entering the paraffine itself.

At points where the paraffine had been deposited in dense tissue like the fascias and in the inguinal canal external to the sac, the masses were adhered by a development of connective tissues which penetrated the paraffine. This was particularly true of the smaller masses, and in one instance, where the original mass probably was no larger than an almond, the entire mass was permeated with connective tissue, breaking up the paraffine into innumerable small globules. In one case, aside from a nodule that had been injected near the internal ring, a part of the paraffine was deposited accidentally intradermally and immediately beneath the papillary layer, creating a reddened indurated area. A microscopical examination of this dermal nodule showed an invasion of connective tissue, breaking the mass into numberless small globules, suggesting an attempt at final absorption.

How long may paraffine remain in the tissues before absorption, if it ever does, is complete? This question may be illustrated by an experience not connected with hernia, but by a case that had been a carrier of paraffine that had been injected four years previously.

A middle-aged attractive woman had been persuaded by a beauty doctor that he could endow her with perpetual youthful facial beauty if he would be permitted to inject paraffine at points in her face usually occupied by wrinkles which were the forerunners of senile manifestations. She readily consented. Masses of paraffine were deposited above and between the brows, the outer corners of both eyes and the angles of the mouth and in the nasal folds, and, to complete the cosmetic work, several globules were injected to improve the nasal contour. All the injections were subcutaneous. For a short period following the treatment there were no visible changes. In about three months reddened areas developed over all the injected points. These areas became more pronounced, increased in extent so that the face finally presented the appearance of an extreme chronic alcoholic.

When she presented herself for consultation, which was more than four years after the treatment, she exhibited extremely reddened and distorted features with prominent nodules at all injected points. Her nose was especially large and swollen like that of the proverbial coachman.

She desired to have the paraffine removed. It was finally decided to excise it with a scalpel. Every nodule was firmly attached to and was permeated by connective tissues; they were dissected out with difficulty. The pathologist's report by Dr. O. S. Schultz was as follows:

Considering the duration of the inflammatory process set up by the action of the injected paraffine, the lesion is striking in the absence of differentiated fibrous tissue and of newly formed blood-vessels. In spite of the latter factor, necrosis is absent, peripherally, as well as further in; the inflammatory tissue has the same subacute, proliferative character, and there has been no peripheral walling off by fibrous tissue. The injected paraffine is absent in the prepared sections (it was probably dissolved out in the staining process), but there can be no question but that the spaces present, and they were numerous, in the tissues represent the situations of the paraffine. The latter, since it is not removable, must act continuously as an inflammatory irritant. The character of the tissue reaction indicates that it acts as an irritant of low grade of intensity. Where the paraffine was present in larger amounts it appears to have caused hyaline degeneration and atrophy of the stroma rather than proliferation.

While the paraffine is not soluble and cannot be completely removed, it apparently can be broken up by the proliferating tissues, as the small size of the vacuoles in the more cellular tissues and the vacuoles present within the giant cells would indicate. In order that fragmentation of the paraffine could occur, the injected paraffine must have had a low melting point which rendered it soft at body temperature. The prolonged and continuous inflammatory reaction set up in this case shows that paraffine injected into the tissues cannot be considered an entirely inert and innocuous substance.

In studying our cases it was found that the least change took place when the paraffine was deposited in loose connective tissues. Moderate changes in form of connective tissue invasion occurred when it was deposited in dense structures. If deposited intradurally about the inguinal canal or intradermally it infiltrated the tissues and became a source of irritation, setting up a prolonged and continuous inflammatory process. When the mass was deposited in loose areolar tissues there was no apparent inflammatory reaction except for the formation of a limiting connective tissue wall. The paraffine masses remained unchanged. The amounts injected varied greatly. The smallest amount was not less than one drachm and the largest quantity weighed sixteen ounces.

This brief discussion is based on a report of the following cases, ten in number, which were operated by the writer for the removal of the injected paraffine with an intention to cure hernias.

CASE I.—A. B., merchant, weight 225, age forty, entered my service at the Methodist Episcopal Hospital suffering with urinary retention due to organic stricture situated in the prostatic urethra. Forcible catheterization previous to admission had produced traumatisms leading to perineal urinary and sanguineous infiltrations. A sound could be passed only to the prostate. Six months earlier he had been subjected to paraffine infiltrations for the cure of a large right-sided inguinal hernia. In spite of a thick layer of adipose tissue on the abdomen and in the groin, a hard mass the size of a goose egg could be palpated over the external inguinal ring and another extending downwards into the scrotum and smaller masses in the perineum. A suprapubic puncture to relieve urinary retention had been attempted without success. The urgency for the relief from the distress of an overdistended bladder was great. A suprapubic cystotomy, under ether, was done shortly after admission. The bladder being opened and emptied of a large amount of urine, a block tin sound was passed into the upper urethral end down to the prostatic obstruction. A median perineal incision was made dividing the cicatricial structures down to the point of the sound. The tissues involved in the stricture were divided so that the tip of the sound could be pushed through the perineal wound. A mass of paraffine about the size of an English walnut firmly imbedded in the tissues and lying to the right side of the urethra anterior to the prostatic urethra was removed. This mass extended upwards and was connected with the paraffine near the external inguinal canal. A rubber tube was introduced protruding from both suprapubic and perineal wounds creating a through-and-through drainage. The day following his operation he had completely recovered from the conditions of shock which existed when he entered the hospital, but he complained of pain in the right groin at the site of the paraffine mass. He had had a free bowel movement during the night and, since no intestinal protrusion in the right groin could be felt, it was hoped that the local pain was due to paraffine irritation. The pain became less in the course of a week.

On the tenth day there was a sudden enlargement of the mass in the groin accompanied by intense pain. It was apparent that an intestinal loop had descended beside the paraffine, resulting in incarceration. An immediate operation confirmed this conclusion. An incision through the thick layers of fat disclosed a hard goose-egg-sized mass over the external inguinal canal. Other rounded nodules were felt, one extending upward along the groin to the extent of four inches. A second one, ovoid in shape, extended downward to the perineum. A third one extended into the obturator foramen, a fourth mass pointed along the surface of the horizontal pubic ramus. All normal anatomical lines were obliterated. Each mass was firmly attached to the tissues and was dissected out with difficulty. After their removal the spermatic cord was found to be infiltrated so that it presented itself like a section of hard rawhide cord. The hernial sac wall was stiff and hard, as if it contained paraffine, but none was found in its interior. A mass at the external ring had compressed the circulation in the intestinal loop within the sac so as to obstruct its circulation, giving the appearance of a strangulation. The hernia was closed by the imbrication method. The entire mass of paraffine removed exceeded the size of a double fist and weighed sixteen ounces. A great deal of paraffine remained infiltrated in the tissues which could not be removed.

Case II.—G. L., aged forty, a stock dealer. One evening the writer was summoned in haste with instructions to bring a complete operating outfit to operate a strangulated hernia on a man at his own home. His condition seemed to forbid his being moved to a hospital.

On arriving at the bedside, a strangulated right-sided inguinal hernia, complicated by a large mass of paraffine which had been injected more than a year previously, was found. The patient was in great pain, had an almost uncountable pulse, rapid, shallow respirations; in every way he seemed in extremis. Hasty preparations for an immediate operation were made. Under a rapid light ether anæsthesia the operation was begun. The usual incision revealed a large flattened mass of paraffine, which extended upward from the external inguinal canal to the extent of four inches and outward along the inguinal canal to a distance of five inches. Three hen's-egg-sized paraffine nodules were embedded below Poupart's ligament in Scarpa's triangle; another, a walnut-sized nodule about two inches below the external ring and between this and the first-named mass could be felt; the hernial sac was tensely distended and almost black in color. All these masses were intimately and firmly attached to the surrounding connective tissues. A most tedious dissection followed. All normal anatomical lines were obliterated. Finally all the paraffine was removed. The sac was opened; it contained a black intestinal loop which still retained its gloss. It was returned into the abdominal cavity. The hernial canal was repaired with tier sutures by the usual imbrication method. Recovery uneventful.

Case III.—J. S. M., age twenty-five, admitted to my service at the Methodist Episcopal Hospital. He was suffering from an irreducible left-sided inguinal hernia. A hard hen's-egg-sized mass could be palpated overlying the external inguinal canal. The patient volunteered

the information that he had undergone the paraffine treatment eight months ago. Under ether anæsthesia, and through an incision, an ovoid mass of paraffine, the size of a large hen's egg, was easily shelled out, leaving a distinct coating of paraffine in the walls of its bed and extending into the hernial canal and infiltrating the spermatic cord. The inguinal canal was large enough to permit the passage of an intestinal loop. The pressure from the paraffine interfered with the return circulation and effectually prevented a reduction of the hernia. After dividing the fascia of the external oblique up to and above the internal ring, the hernial sac was opened; the intestinal loop was intensely congested but retained its gloss. It was reduced. The closure of the canal was with chromic gut sutures. Recovery was uneventful.

Case IV.—J. G., railroad brakeman, age thirty-five years. More than a year prior to admission he had undergone the paraffine treatment, but his hernia had recurred and it had become very painful.

On examination there were found in his left groin three hard spherical masses. Two of these were the size of English walnuts located below Poupart's ligament, and a third, the size of an ordinary lemon, was firmly attached to the fascia of the external oblique at a point between the external and internal inguinal rings, exerting only enough pressure on inguinal canal to interfere with a return of the protruding intestinal loop. This mass was only loosely attached to the subcutaneous tissues but firmly adhered to the oblique fascia. The two smaller masses were only loosely attached and were easily removed. The usual radical operation completed the operation (Ferguson-Lucas Championniere). Recovery smooth.

Case V.—C. F., age twenty-five, farmer. Right-sided oblique inguinal hernia treated with paraffine eighteen months prior to his visit to the writer. An examination revealed a hen's-egg-sized, irreducible, fluctuating swelling at the right external ring. Cough and strain produced a distinct impulse. Over that swelling and to its outer side, nearly within external ring, existed a hard, rounded, circumscribed, walnut-sized mass. It was not freely movable. It appeared firmly attached to the muscular fascia. It appeared that the hernia reappeared soon after the treatment, although several paraffine injections were given. At first reduction could be effected by palpation, but for a year past the hernia could not be reduced. Much pain and discomfort gradually developed.

Operation.—The usual inguinal incision disclosed both hernial sac and paraffine mass at the same time. The paraffine being more prominent was removed. It was firmly attached to the external oblique fascia by connective tissue evidently penetrating the mass. The loose areolar connective tissue had become closely attached to the paraffine so that the mass was dissected out. The mass was pressing on the outer side of the inguinal canal so as to materially reduce its lumen and seemed to interfere with reduction.

In the hernial sac there was a small amount of paraffine which was attached by connective tissue filaments to the intestinal and sac walls. The paraffine was easily detached, leaving a small area of defective

intestinal serosa which was infolded with several sutures before the loop was returned. The usual radical herniotomy terminated the operation.

CASE VI.—I. O. D., farmer, age twenty, appeared at the usual afternoon consultation hour. He stated that nearly two years previously he had received one paraffine injection for the cure of a right inguinal hernia. The injection had been made without any previous preparatory treatment except that the hernia was reduced. The operator used a syringe consisting of a metal barrel that would hold about two ounces. To it was attached a long needle. This was plunged through the skin without the slightest attempt to disinfect it. A small amount was forced into the region over the external canal. In twenty minutes he was pronounced cured. The fee having been paid in advance, he was politely invited to retire.

An examination revealed a small, illy-defined hard mass no larger than an almond over the external canal; a hernial loop was lying below it. Reduction was effected with difficulty.

Operation.—An incision laid bare a hard almond-sized mass that dipped into the inguinal canal to about one-half its length. The canal was laid open and the mass was dissected out. It appeared like a fibrous neoplasm and not until it was sectioned could the existence of paraffine be determined. Connective tissues had penetrated throughout the mass. The paraffine had been broken up into minute particles which were confined in small cellular spaces. No paraffine was found in the hernial sac. The usual radical herniotomy followed.

CASE VII.—J. D., aged forty, mechanic. Presented himself at the afternoon consultation hour. He stated that he had been treated eighteen months previously with paraffine injections for the cure of a right-sided inguinal hernia. On examination a large, hard, oblong mass, beginning at the pubic tubercle and extending outward to the iliac spine, was found. The individual was rather corpulent. The paraffine mass appeared to be in rather loose adipose tissue. There was much pain in the inguinal canal, but a loop of intestine could not be felt because it was overlaid by the paraffine.

Operation.—Under ether anæsthesia a long incision extending from the anterior superior iliac spine to the pubic tubercle was required to expose the large mass of paraffine. None of it had entered the inguinal canal. It was spread over the external ring, permitting the descent of an intestinal coil. The entire mass of paraffine after its removal weighed eleven ounces and was introduced at five different sittings. The mass was found in several large compartments with no adhesions except at the internal ring where connective tissue had evidently penetrated the mass. The usual herniotomy (Ferguson imbrication) was done. Recovery prompt.

CASE VIII.—M. D. S., age twenty-one, brakeman, came to the Methodist Episcopal Hospital. He stated that he had undergone the paraffine treatment for hernia nearly two years previously. He was not certain whether his hernia was cured on account of the swelling due to the paraffine. He stated that he had almost constant local pain.

Examination disclosed a rather flat, round, hard, oblong mass twice the size of a silver dollar. It was located intradermally and immediately beneath the papillary layer in the subcutaneous connective tissues. It was not attached to the deeper structures. Beneath it could be felt a protruding intestinal loop.

Operation.—The skin incision passed through the hard mass. It was found that the entire mass was permeated with connective tissue; the paraffine could not be separated, but it was necessary to excise the skin and all like a neoplasm. No paraffine was found in the inguinal canal. A radical herniotomy concluded the operation.

CASE IX.—T. B., aged twenty-four, farmer, presented himself with three rounded, walnut-sized masses in the right inguinal margin. One mass rested slightly above another to the outer margin and the third below the external inguinal canal, and, posterior to all of these masses, protruded an intestinal loop which was painful and tender to touch. It receded with recumbency. About fifteen months previously three injections of paraffine had been made, all at the same sitting.

Operation.—The usual incision exposed three paraffine nodules inclosed in fairly circumscribed connective tissue inclosures. They had formed no cellular attachments and were easily lifted out of their beds. None of these lumps had exerted the least pressure on the external ring or any part of the inguinal canal, nor was there a particle of paraffine in the inguinal canal. The shots had missed the target entirely. The usual radical herniotomy concluded the operation. Recovery uneventful.

CASE X.—J. L., real estate dealer, aged forty, came to the Methodist Episcopal Hospital to be operated for a right-sided inguinal hernia which had been unsuccessfully treated with paraffine. He stated that eight years previously he had received two injections of paraffine. Only a short time afterwards he felt a recurrence. He could plainly feel an intestinal loop in the scrotum when he assumed the upright position, and it usually disappeared when he lay down. But occasionally it was reduced with difficulty.

On admission a hard mass the size of a hen's egg could be palpated in the right groin immediately internal to and beneath the external ring. Behind this mass a reducible swelling was palpable. An incision revealed an ovoid smooth paraffine mass which was easily removed. Another mass could be felt behind the cord. This mass was oblong, nearly three inches long, and nearly one inch in diameter. It occupied a cavity with smooth walls and was easily taken out. The hernial sac and the cord passed between the two masses. There were no adhesions in the sac. The operation was finished by the Ferguson-Championniere method. Recovery per primam.

One cannot but wonder why the paraffine method for the treatment of hernia has survived. The foregoing cases would seem to demonstrate the inefficiency of the procedure. One can easily see the reasons for failure in the cases where injections had been made regardless of the anatomy and underlying conditions which constitute a hernia. But in several of our

cases the masses had been introduced at least partly in the inguinal canal and partly into the sac itself, and yet recurrences occurred. The reason for this is found partly in the fact that the inguinal sac was not completely obliterated and partly in the fact that the attenuated internal oblique muscle and the conjoined tendon were in no way reinforced or affected by the extraneous substance. Since it is impossible to determine the exact structural defects in any hernia without their exposure by incision, it follows that it is impossible to know where to deposit the paraffine and how much is necessary to reënforce the weakened tissues. It would seem that a so-called cure rested on a lucky chance. It is probable that cases of incomplete hernia with a short sac may be benefited by paraffine introduced into the inguinal canal producing its compression, but certainly no obliteration. Some of these so-called cures are deceptive as was shown by two cases who consulted the writer for other conditions. In both of these cases the individuals believed themselves to be cured. In both the paraffine masses were conspicuous under the skin and easily palpable by the patients, but they were unable to feel the intestinal loops beneath the paraffine nodules that could easily be palpated by the surgeon. Both of these individuals had been enthusiastic in their praise of the method and were the means of inducing many others to try the procedure. It would be instructive to examine a large number of these alleged cures to ascertain how many of them were carrying obscured hernias. It is more than probable that many of them are converted into concealed ruptures discoverable only by those trained and skilled in the diagnosis of these conditions.

HYPERNEPHROMA IN THE FOLDS OF THE FALCIFORM LIGAMENT OF THE LIVER*

By F. N. G. Starr, M.B. (Tor.)
of Toronto, Canada

On January 24, 1917, I was consulted by a female patient, a spinster, aged thirty-five years. She complained of pain between the shoulders, extending up the back of the neck; sometimes severe headache. She had a sallow complexion, a weary expression of countenance, and looked much worn. The breathing was labored. There was a history of a gradual loss of appetite with flatulence coming on immediately after eating. The bowels were regular; she weighed 159 pounds. There was no menstrual disturbance.

A physical examination revealed a mass most prominent in the epigastric region, extending from the costal margin above to about four inches below the level of the umbilicus. There was dulness on percussion over the entire mass, and this was continuous on the right side with the liver dulness, which extended upward to the lower border of the third costal cartilage in front. There was resonance under the costal margin on each side and this continued down to Poupart's ligament. Between the lower end of the mass and the symphysis pubis there was also resonance. As indicated in the diagram (Fig. 1) the growth extended a little more to the right than to the left. One could detect a definite though dull and slowly transmitted fluctuation wave. On palpation there was a distinct pulsation over the whole area. With the stethoscope one could hear a loud *bruit*, while to the right of the middle line, the *bruit* was not only loud, but crudely musical, resembling somewhat the noise of an express train passing through a closed station.

After an opaque meal the X-ray showed the stomach crowded well to the left side and vertical (Fig. 2). It emptied on time. Renal function was normal.

The diagnosis lay between (*a*) an atypical pancreatic cyst, but there was no history of an injury, nor of frequent attacks of epigastric pain, nor was there the prostration that I have observed in the few cases that have come under my observation; (*b*) an hydatid of the liver was kept in mind, but the patient had always lived in Toronto and even in holiday time she had not visited sheep growing areas; the right lobe of the liver did not seem to be invaded but there was that "jelly-like" fluctuation that is described as almost characteristic; (*c*) a collection of fluid in the lesser sac due to a pathological closure of the foramen of Winslow came into one's mind, but there was no history of any intraperitoneal trouble that might give rise to such closure.

Operation.—February 28, 1917. An incision was made a little to the left of the median line extending from the ensiform cartilage to a point half way between the umbilicus and the pubes, when an enormous

* Read before the American Surgical Association, May 31, 1917.

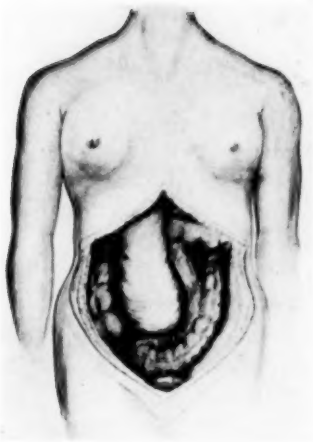

FIG. 1.

FIG. 2.

FIG. 3.

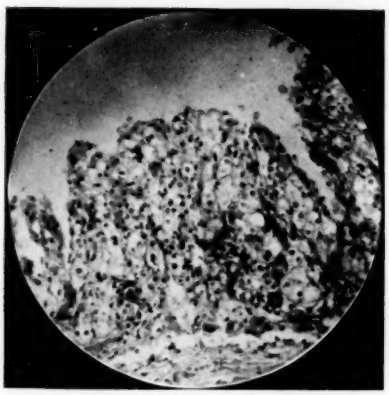

FIG. 4.—Low power.

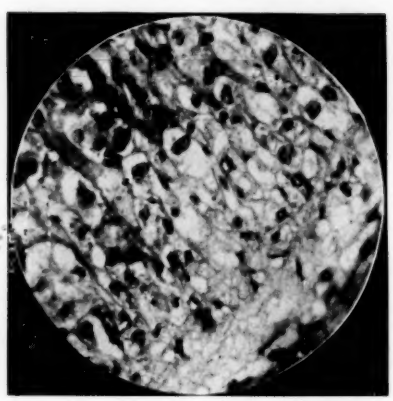

FIG. 5.—High power.

reddish brown tumor (Fig. 1) presented in the wound, having across it a network of fine yellow lines. Had the growth been in the posterior mesentery or in the retroperitoneal tissue, one would at once have recognized its character from its appearance. It seemed to have a broad attachment above, and finally I discovered that it was between the layers of the falciform ligament, which were of course enormously stretched. By dividing this tissue close to the liver I was able to remove the whole mass without rupture.

As the growth was transferred to a basin, a forceps that was still attached caught on the basin and punctured the mass, some of its contents—thick grumous material—escaping into the basin. This made me realize the probable malignant nature of the growth. Consequently, in closing the abdomen I was careful to bring forward the cut edges of the falciform ligament and suture them together, along with the cut edges of the peritoneum, thus reconstructing the ligament and closing the peritoneal wound with the same suture. At the same time, should recurrence take place it is made easy of access, and the recurring growth would be extraperitoneal. The tumor weighed eight and a half pounds (Fig. 3).

The patient has made an uninterrupted recovery, is now enjoying excellent health, and weighs 138 pounds.

Prof. MacKenzie of the Department of Pathology reports:

The tumor in the gross, as received in the laboratory, is a large globular mass, about thirty centimetres in diameter. The main mass of the tumor is soft and breaks down at once when cut. It contains a large amount of blood and blood-clot, and when this is removed there remains a soft débris which contains a quantity of fat.

Towards the margin the tumor is firmer and of a yellowish tint, and the whole is surrounded by rather firm fibrous tissue; at one side are remnants of liver tissue, apparently outside the fibrous capsule.

The central area of the tumor is difficult to cut on account of the extensive hemorrhage and necrosis, but when sections are obtained the tissue is made up of large, rather polygonal vacuolated cells arranged as cords and columns about irregular blood sinuses. The vacuoles do not contain fat, although a good deal of fat is present as large droplets between the cells. On account of the fixation it is impossible to say whether there is glycogen in the tumor cells. The nuclei vary very much in size, but are large, with a large nucleolus and a relatively small amount of chromatin. Mitotic figures can be found but do not seem to be common. In places there is evidence of direct cell division. Towards the margin and more solid portion there is less fat and hemorrhage. The cells also seem more compactly arranged.

The most interesting point is that immediately within the fibrous tissue and among the tumor cells are a few cords of liver cells. Further in these cannot be found.

The fibrous tissue is not a true capsule but contains bile ducts and islands of liver tissue simulating an abnormal type of cirrhosis.

The general appearance of the tumor under the microscope more nearly approaches that of a hypernephroma than any other type, but the resemblance is not absolute (Figs. 4 and 5).

On the other hand, it is difficult to understand the small areas of liver cords in the margin of the tumor within the capsule, and the possibility of a tumor

arising from the liver itself must be thought of. The general character of the cells, and especially of the nuclei, unquestionably suggests malignancy and the prognosis should certainly be guarded.

This condition must be exceedingly rare. Pepéré[1] reports a case of hypernephroma in the right lobe of the liver, but how adrenal rests can find their way between the layers of the falciform ligament is difficult to understand, especially when one remembers that the first traces of cortical substance do not appear until the embryo has reached a length of 6 or 7 mm., by which time considerable liver substance and the inferior vena cava will intervene between it and the falciform ligament, while the chromaffin tissue from which the medulla is formed does not appear until the embryo is about 15 to 20 mm.

As the right suprarenal ridge runs on to the dorsal surface of the liver, an aberration in its migration might result in some rests reaching the liver margin. Should it so happen that one of these rests be situated near the reflection of the falciform ligament and undergo a rapid proliferation, the line of least resistance would be downward between the peritoneal layers of the ligament.

It would be unwise for me to enter into a discussion of the histopathology as to whether these tumors really spring from adrenal rests or from the Wolffian body. This I shall leave to Dr. Louis B. Wilson,[2] of the Mayo Foundation, to whom I purpose turning over the material for further study in recognition of his masterpiece on hypernephroma.

[1] Pepéré: Archiv. de Méd., Paris, Experimentale et d'Anat. Path., 1902.
[2] Louis B. Wilson: Jour. Med. Research, January, 1914.

CHOLECYSTECTOMY

UNDER WHAT CIRCUMSTANCE SHOULD IT BE DONE?*

By Miles F. Porter, M.D.
of Fort Wayne, Ind.

The fearful fallacies that figures may lead to unless they be studied in connection with all related facts is nowhere more clearly shown than in the various papers, published in late years, on the relative merits of cholecystectomy and cholecystotomy. These papers likewise show how true it is that facts are quite as fallacious as figures.

Jones, for instance, in studying a series of his cases finds that he has secured 20 per cent. more cures by cholecystectomy than by cholecystotomy; and Brown, by a little study, gets the same result, whereupon both Jones and Brown conclude that cholecystectomy is to be preferred to cholecystotomy. A comparison of Jones' figures with Brown's, however, shows that the former (Jones) gets 20 per cent. more cures in both operations than the latter (Brown). The same logic used in arriving at a decision in favor of cholecystectomy would, if based upon a comparison of Jones' figures with those of Brown, lead to the conclusion that Brown should quit doing gall-bladder surgery and turn it over to Jones.

The writer felt impelled to make the foregoing remarks after a somewhat extensive study of the literature of gall-bladder and gall-duct surgery that has been published within the last decade—the results of which study are incorporated in another paper.[1] As a result of that study, coupled with a personal experience covering about 1000 cases of surgical disease of the gall-bladder and gall-ducts, the following conclusions have been reached:

1. The gall-bladder in man is a very important organ, though not a vital one.

2. Cholecystectomy is followed by an increase of bile pressure within the ducts and thus enhances the danger from pancreatitis.

3. The cause of the symptoms in so-called gall-bladder disease resides only relatively infrequently in the tissues of the gall-bladder.

4. Recurrence of symptoms after cholecystotomy means, in the majority of instances, overlooked stones, reformation of stones, infection of the bile stream, or hypercholesterinæmia.

Assuming that the first conclusion, *i.e.*, that the gall-bladder in man is an important organ, is concurred in, it necessarily follows that the gall-bladder should never be removed save when its removal is necessary for the cure of the disease for which the operation is done.

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* Read before the American Surgical Association June 1, 1917.

[1] Journal American Medical Association, 1917.

The object of this paper is to discuss the question—When is the removal of the gall-bladder necessary?

It is generally agreed that gall-bladders of the following types would better be removed:

1. Hydrops with obliteration of the cystic duct.
2. Calcareous or fibrous degeneration.
3. Chronic empyema.
4. The cholesterin or strawberry gall-bladder.
5. Carcinoma—provided it is limited to the gall-bladder.
6. Extensive laceration or perforation.

Many would perhaps add to this list gangrene of the gall-bladder. However, many patients with gangrene of the gall-bladder are desperately ill and will die if cholecystectomized, but will recover if a simple cholecystotomy and drainage operation is done. I have had several cases which support this position, as have Deaver and other operators. It may be said then that in cases of gangrene of the gall-bladder, cholecystectomy is the operation of choice only when it may be done without adding materially to the operative risk, and that all other cases of this kind should be treated by simple drainage. One occasionally meets with circumscribed gangrene due to pressure of a stone accompanied by acute cholecystitis. In many such cases cholecystotomy is to be preferred to cholecystectomy.

How about the acutely infected gall-bladder with thickened œdematous walls?

It is the author's experience that patients with gall-bladders of this type are practically always completely and permanently cured by cholecystotomy. In a hundred or more cases of this type I know of none that have recurrence of trouble provided at the time of operation or within a day or two thereafter there was a free flow of bile into the gall-bladder. Some of these patients were operated twenty or more years ago and are still living and well. Buchanan[2] states that of 212 cholecystotomized cases in which note of this fact was made he found that only 8.5 per cent. of those in which it was noted that the bile flowed freely into the gall-bladder were not entirely cured, whereas in cases where the bile did not flow at all 45 per cent. were not entirely cured. The prognostic importance of the flow of bile into the gall-bladder at the time of operation or shortly thereafter is at present, I think, underestimated. Attention to this point will often enable the surgeon to choose wisely as between cholecystectomy and cholecystotomy. That the gall-bladder has remarkable power of recuperation has been demonstrated many times.

Does the return of symptoms after cholecystotomy usually mean, as is held by some, that cholecystectomy should have been done?

My own experience and the study of the reported cases compel me to dissent from this view. In my own work cholecystectomy was done in 10 per cent. or less of all cases, and of this 10 per cent. there was failure to

[2] Surgery, Gynecology and Obstetrics. Vol. 21, page 504, 1915.

get complete cure in two cases, whereas in the remaining 90 per cent. there was failure of cures in five cases. In other words the failures following cholecystotomy were in proportion less than half those following cholecystectomy. There is no pretense that this calculation is based upon an exact tabulation of all cases, nor is it questioned that some failures in both types of cases have occurred without my knowledge. On the other hand, there can be no question but that in the writer's experience cholecystotomy has given a larger percentage of satisfactory results than has cholecystectomy. It goes without saying that malignant cases do not enter into this consideration.

Stanton,[3] who has presented one of the best studies of which I know on the subject of reformation of gall stones, says, "The reported cases do not bear out the assumption that cholecystectomy affords a much greater immunity against reformation of calculi than does cholecystotomy." My own experience is in accord with this. It is self evident that removal of the gall-bladder will not cure cholesterinæmia. Cases of this type, as has been pointed out by Aoyama,[4] Gerster,[5] and Rothschild,[6] are not in need of surgery at all, but are to be cured by a careful attention to diet, which consists largely in using only such foods as are poor in lipoids. It should be remarked in this connection, as was done by Gerster in his article previously referred to, that the hypercholesterinæmia may pass while the bile still contains a sufficient excess of cholesterin to produce symptoms, and that a persistent high cholesterin content of the blood strongly suggests common duct obstruction, especially if there are attacks of pain, and that the absence of jaundice proves nothing. It appears to the writer illogical to remove a gall-bladder in cases wherein the bile stream is infected except in those cases in which it seems clear that the infection comes from the deep structures of the gall-bladder—in interstitial cholecystitis, if you please. Rhoads [7] reports several cases which seem to show that the administration of hexamethylenetetramine has a curative affect in bile stream infection. The average duration of drainage in 56 cases in which the drug was given was over six and one-half days less than in those in which it was not given. Rhoads also reports cases with recurrence of symptoms that were cured by the administration of this drug. One of the arguments advanced in favor of cholecystectomy is that the morbidity following this operation is less than is the morbidity following cholecystotomy. This is unquestionably true, but that it is true is in no small part due to the fact that a larger percentage of patients die, and that more promptly following cholecystectomy than following cholecystomy. With this exception the writer's experience is that the increased morbidity of cholecystotomy as compared with cholecystectomy consists in the slight inconvenience caused by the bile drainage.

[3] Annals of Surgery, vol. 61, page 226, 1915.
[4] American Journal Medical Sciences, 1915, page 764.
[5] Gerster, Progressive Medicine, June, 1916, page 164.
[6] American Journal Medical Sciences, 1916, page 394.
[7] Surgery, Gynecology and Obstetrics, October, 1916, page 399.

With the present state of knowledge the last word on the subject of the surgery of the gall-bladder and gall-ducts may not be said. However, at the present time the conclusion seems warranted that it is neither necessary nor advisable to remove the gall-bladder except when it is diseased or injured beyond the probability or possibility of restitution, and that this power of restitution may be presumed to be lost only when one or the other of the following conditions obtains:

1. Hydrops with obliteration of the cystic duct.
2. Calcareous degeneration or fibrous degeneration with contraction.
3. Chronic empyema.
4. The cholesterin or strawberry gall-bladder.
5. Carcinoma.
6. Extensive laceration or perforation.
7. Gangrene other than localized gangrene, such as is sometimes caused by pressure of a stone.

ACUTE SUPPURATIVE CELLULITIS OF THE STOMACH*

WITH REPORT OF THREE CASES

By Emmet Rixford, M.D.
of San Francisco

Acute suppurative cellulitis of the stomach, otherwise known as phlegmonous gastritis or gastric phlegmon, has long been known to pathologists, and occasionally has been met with by surgeons in exploratory abdominal operations. It is commonly reckoned as one of the rare affections of the stomach, for scarcely more than 150[1] cases in all have been reported. The increasing frequency, however, of publications of reports of cases during the last three or four years would seem to indicate that it is not so rare as commonly supposed.

In default of diagnosis before operation or autopsy the few cases which possibly recover are lost, as are the many in which the cause of death has not been verified by autopsy. Doubtless, too, in many cases of carcinoma and chronic ulcer of the stomach infective cellulitis is the immediate cause of death, but, being in the relation of a secondary affection, if recognized, it is apt to be looked upon as merely a complication, and hence receives little attention, or it is put aside as a terminal stage of an otherwise fatal malady.

The earliest cases reported (Borel, 1656; Sand, 1695; Lieutaud, cited by Schnarrwyler) were cases of localized abscesses of the stomach wall. Brinton (Lectures on Diseases of the Stomach and Intestines, 1859) gave an excellent description of the disease under the title "Suppuration of the

* Read before the American Surgical Association, June 1, 1917.

[1] In view of the almost invariably fatal outcome (only one case cited by Emge, in which a diagnosis was made, is said to have recovered spontaneously, and one, the case of Fritz Koenig (*Deutsche m. Woch.*, 1911) recovered following a prompt gastrectomy; the case of Bovee (*Am. J. Med. Sci.*, May, 1908), which was rather one of localized abscess of the stomach wall than of a diffuse phlegmon, recovered after evacuation of the abscess and drainage through an abdominal incision in spite of the fact that the patient was six months pregnant at the time and aborted soon after operation; of this case, however, no bacteriological examination appears to have been made) it is clearly the duty of everyone who has observed such a case to record it in order that the actual frequency of the affection, its nature, cause, manner of development, and clinical aspects may be better and more widely known, to the end that diagnosis may be made early, at least before operation or autopsy, and if the proper treatment be finally determined to be surgical that the surgical indications and procedure shall be clearly defined. At the present time gastric phlegmon is still little else than a pathological curiosity, though it is an affection of which a good many people die. A very considerable literature on the subject has been built up, and it has been a favorite subject for graduation theses of German medical students, in whose "Inaugural Dissertations" may be found excellent bibliographies as well as reports of cases from the German clinics. See the dissertations of Klaus Erlangen, 1857; Löwenstein (Keil, 1874); Reinking (Keil, 1890); Jacoby (Koenigsberg, 1900); Schnarrwyler (Basel, 1906).

Areolar Tissue of the Stomach," and suggested the name "suppurative linitis," thereby distinguishing this affection from "cirrhosis of the stomach," for which he suggested the name "linitis plastica," which we now call Brinton's disease or "leather-bottle stomach." Brinton described the affection as beginning with pain, burning sensations, thirst, persistent vomiting, followed by febrile excitement, which rapidly merges into prostration, which is associated with delirium and ends in death by coma in from forty-eight hours to a few days from the commencement of the attack.

He called attention to the occurrence in some cases of a "chain of small abscesses more or fewer of which have burst through correspondingly small and distant orifices in the mucous membrane," and stated that "in its circumscribed form it may inaugurate an ordinary ulcer," but that such a commencement of gastric ulcer is very rare, and he also remarked that the disease is related to pyæmia. But since Brinton's knowledge of the pathology of the affection was gathered from post-mortem examinations he speaks of the "rottenness" of the tissues of the stomach wall as being rather characteristic. He cites Dittrich (Schmidt's Jahrbuch, b. 72, p. 303, 1851), who made the observation, interesting in view of the subsequent determination of streptococci as the bacterial cause of the affection, that during an epidemic of puerperal fever in Prag many cases of suppurative inflammation of the submucous tissue of the stomach occurred, the stomach wall being sometimes more than an inch thick. Dittrich also called attention to the frequent occurrence of erysipelas in relation with such cases.

Löwenstein (Inaug. Dis., Keil, 1874) collected 23 cases of gastric phlegmon, and gave credit to Heller in Kiel of having found cocci in such a case in that same year. In 1885 Sebiklon found streptococci in a case of gastric phlegmon. Since then many cases have been studied, and in practically all of them streptococci have been found, most frequently in pure culture, and where in mixed culture most commonly associated with staphylococci.

Doubtless the nature of the organism of infection together with the relative inaccessibility of the site of infection, the rapidity of its course, the difficulty of diagnosis, and the serious operative risk on account of the early depression of the patient and the practical impossibility of avoiding dissemination of the infection in the peritoneum, amply account for the high mortality.

It is also not unlikely that the persistaltic action of the stomach muscle and the churning action of respiration, as well as the act of vomiting, may favor spread of the infection through the loose cellular tissue between muscle and mucosa.

Clinically, gastric phlegmon is characterized by a sudden onset beginning with pain in the epigastrium, chill, burning sensation in the stomach not relieved by drinking fluids, early and persistent vomiting, fever which may be slight and rise gradually, but which has been known rapidly to reach 105 or 106, early prostration, tenderness most often to the left of the median line, leucocytosis, 10,000 to 20,000 with high percentage of poly-

morphonuclears, sometimes palpable gastric thickening making a diffuse tumor movable on respiration, often with congestion at the base of either or both lungs. This early stage is soon followed by hiccough, increasing prostration, muscular rigidity at first in the epigastrium, running pulse, cyanosis, cold extremities, sometimes diarrhœa followed by constipation and abdominal distention, evidences of profound sepsis and advancing peritonitis. If the patient lives long enough, portions of the gastric mucous membrane may slough and come away in the vomitus. Death ensues in from three to ten days.

The diagnosis is difficult, for the earlier symptoms are common to several affections.

Basal pneumonia is difficult to exclude, except by waiting, and this is fatal in gastric phlegmon. However, basal pneumonia is apt to be unilateral, marked by relative increase in rate of respiration, less marked epigastric tenderness, and absence of palpable tender tumor.

Hemorrhagic pancreatitis is quite as fulminating in its onset as gastric phlegmon, but commonly has a higher leucocytosis with less fever—often no fever at all.

Perforation of gastric ulcer is marked by a more sudden, even explosive, pain, followed almost at once by muscular rigidity over a rapidly increasing area.

Acute gangrene of the gall-bladder has right-sided symptoms, perhaps the history of attacks of cholecystitis or biliary colic, and often the distended gall-bladder can be felt.

If the matter of diagnosis be viewed from the standpoint of establishing indications for surgical intervention the problem is much simplified, for the surgical world is agreed that early operation offers much the best chance for the patient suffering from gangrene or perforation of the gall-bladder, perforation of a gastric or a duodenal ulcer, acute hemorrhagic pancreatitis, etc. Only in pneumonia is abdominal section likely to do positive harm, and here an opening made under local anæsthesia is not very dangerous and may be the only possible means of making a diagnosis by exclusion at a sufficiently early period. The other conditions are, of course, evident as soon as the abdomen is opened.

The cases are ordinarily divided into two groups, one in which the portal of entry of the infecting organism into the stomach wall is apparent, the other in which it is not.

Fink (*loc. cit.*) suggested the following elaboration of this classification:

1. Primary or "idiopathic" forms in which the cause is not demonstrable.

2. Secondary forms. These further divided into (*a*) direct extension phlegmons, *e.g.*, from œsophagitis; (*b*) local secondary phlegmons; *e.g.*, those which follow carcinoma or an operation (also ulcer?); (*c*) metastatic secondary phlegmons in which infection of the stomach follows the infection of some other part of the body.

The frequency with which the so-called idiopathic or fulminating forms

follow streptococcal sore throat would seem to make distinction between the primary form and the metastatic secondary difficult to be determined in particular cases. Repeated blood cultures in a large number of cases would be of interest, but it is questionable whether they would be of determining value, because negative findings would be worth little, and in the event of positive findings one could not say that the blood streptococci did not come from the stomach lesion unless blood culture should prove to be negative in a large number of cases of primary gastric phlegmon.

The prognosis would seem to depend on the relative attenuation of the culture—the greater the attenuation the greater the probability of localization in a definite abscess of the stomach wall.

Since in erysipelas and other streptococcal infections the propagation of the bacteria through the tissues is greatly impeded by scar tissue, and even in the fulminating forms of gastric phlegmon, as said above, the infection does not pass the pyloric ring, one would expect the stroma of a carcinoma or the scar tissue of a chronic ulcer to offer an effective barrier against rapid diffusion of the inflammation. This would seem to be the case clinically, for there are many observations recorded of cases with multiple minute abscesses in the walls of a chronic ulcer, whether simple or malignant, and also in cases of chronic cellulitis of the stomach, as mentioned by Brinton (linitis plastica).

It would appear that gastric phlegmon secondary to extensive carcinoma or chronic ulcer of the stomach is less fulminating in its onset and development than the so-called primary cases where no soldering of the loose areolar tissue has taken place. Perhaps, too, the mechanical rigidity of the induration by preventing peristalsis tends to lessen the spread of the infection. It is interesting to note that the cellulitis quite uniformly ceases abruptly at the pyloric ring and at the cardia. This fact is exemplified by Cases I and IV of this report, and, *per contra,* the fulminating character of the inflammation in Case II, in which the ulcer was exceedingly acute, and Case III, in which there was no discoverable lesion, left no room for speculation as to the presence of any inhibitory influence.

It seems probable that in the great majority of cases the streptococci enter the stomach through some lesion of the mucous membrane, but localization in the cellular tissue of the stomach of blood-borne bacteria would seem to occur with some degree of probability, because it would be difficult otherwise to account for such cases as those reported by Dittrich (*loc. cit.*), where foci occurred in the retroperitoneal and perirenal connective tissue and beneath the skin in cases of gastric cellulitis. But these, again, are post-mortem findings.

Bassart [2] thought that the streptococci enter through the squamous epithelium at the cardiac orifice. In Case III of this report (fulminating, diffuse phlegmon) the inflammation appeared to be oldest near the cardia, for in this area alone was there a deposit of fibrin on the peritoneal sur-

[2] Corresp. Bl. f. Sch. Aerzte, 1912, p. 421.

face of the stomach. Cheinisse emphasized the occurrence of phlegmonous gastritis in infectious diseases, notably erysipelas, and Schwartz in infections of the tonsils. Vasilewsky (Russky Vratch, 1915, abs., *J. A. M. A.*) published a typical case in which erysipelas spread to the mouth and pharynx, then to the œsophagus and stomach. Lehnhoff recently (*J. A. M. A.*, March 31, 1917) reported a case in a man of sixty-three with acute sore throat, in whom, after six days, severe chill occurred with nearly continuous vomiting (not bloody), pain in left epigastrium, rise in temperature to 102, pulse 120. A dose of castor oil was given and was followed by large fluid evacuations, but the pain and epigastric tenderness were increased. Operation performed to relieve the progressing peritonitis showed stomach covered with fibrin. There was no ulcer and no cancer. The patient died twenty-four hours later.

It is interesting to note that in this case, in spite of the extensive infiltration of its wall, the stomach responded to the stimulation of the cathartic.

Other cases comparatively recently reported are those of Emge (*Tr. Chicago Path. Soc.*, 1914), of Glascock and of Fink and Oliver (*Tr. Chi. Path. Soc.*, 1916, and *Bost. M. and S. J.*, November 30, 1916), and Tuxen (*Hosp. tidende*, Copenhagen, August 2, 1916, v. 59, No. 31). See also Mintz (*Deutsch. Arch. f. kl. Med.*), Lehnhoff (*J. A. M. A.*, March 31, 1917, v. 69), and Adams (*Lancet*, 1910).

Emge's case occurred in a man of sixty-seven, while in Cook County Hospital for fractured clavicle. Twelve days after entering he was suddenly seized with epigastric pain; an hour or so later he started to vomit profusely. Examination revealed rigidity, tenderness, and tympany; temperature rose to 106, pulse feeble; death next morning. Autopsy five hours later showed typical so-called primary gastric phlegmon, greenish pus exuding from cut sections of the stomach containing pure culture of streptococci, no primary focus detected. Emge published an excellent photomicrograph of cross-section of the stomach showing the enormous thickening of the submucous connective tissue.

Fink and Oliver's case was in a male aged fifty-eight, convalescing from operation, eleven days before, for double inguinal hernia, who developed suddenly symptoms suggestive of peritonitis in the upper abdomen; temperature 99, rising to 102; pulse 96 to 130. Operation showed the stomach thick. The stomach was drained, but patient died eight hours later. Streptococci were found, and no primary focus of infection was made out.

Tuxen claimed that his case was the third on record in which the diagnosis was made before operation or autopsy. The patient was a previously healthy young man under medical observation for measles when he was seized with sudden severe epigastric pain followed by persistent vomiting, paresis of the intestine, and high fever. Operation established the diagnosis; the stomach was drained, but death followed in three days.

Tuxen advises operation in suspected cases, but deprecates doing anything further if the diagnosis is verified.

Kemp (Dis. Stomach, Intest., and Pancreas, 1917) advises laparotomy for diagnosis and relief if possible; if patient does not consent to operation, then the use of ice-bags to the epigastrium, rectal feeding, enteroclysis to relieve tympanites, proctoclysis for sepsis and thirst, opiates as necessary.

For the purpose of determining therapeutic indications with the prognosis in view, it would seem that the cases should be divided into three roughly distinguishable groups:

1. Cases with localized abscesses (the most favorable).

2. Cases with minute multiple abscesses in the presence of inhibitory induration.

3. Cases of widely diffuse cellulitis (the least favorable).

In the first group the indication is clear—viz.: to open the abscess and drain. In the third group the indication is equally clear—to perform total gastrectomy without opening the infected areas if the patient is in reasonably good condition so that there is a chance of success, otherwise to close the abdomen without doing anything further in a surgical direction.

In the second group the surgeon will be put to it to determine the best course to pursue—whether to do a partial or a total gastrectomy. If partial gastrectomy is done the line of section should pass far from the line of palpable induration and beyond any œdematous or reddened areas, for otherwise, as occurred in Case I of this report, the suture line will break down.

Gastro-enterostomy would seem to be contra-indicated except as preliminary to a possible gastrectomy.

In groups two and three drainage would seem to be useless unless it were mechanically possible to open the stomach in some uninfected area, or, if the cellulitis be diffuse, opening with a cautery knife and then slitting the mucous membrane in several places from within the stomach in order to make possible internal drainage, closing the wound in the stomach and draining the region with a gauze pack. I do not know of any such procedure having been attempted.

Of the four cases here reported the first occurred in 1909, the three others in the winter of 1916–1917 during a period in which many physicians of San Francisco had under their care a rather unusual number of severe streptococcal infections, particularly streptococcal sore throats, protracted in their course and followed by many pyæmic and suppurative sequelæ.

CASE I.—Seen with Dr. E. Schmoll. Large, thin-walled carcinomatous ulcer with secondary cellulitis. Woman fifty-six years old, with history of long-standing indigestion without pain but with some discomfort, generally relieved by eating.

About December 12, 1909, consulted physician for epigastric pain. There was local tenderness, slight rise of temperature. A week later

after catharsis palpable thickening was made out above and to the left of the navel, movable on respiration, no muscular spasm, leucocytes 12,000 to 15,000, temperature 100 to 101, very little depression.

December 22: Temperature 102, leucocytes 19,000, tenderness more marked. Operation advised.

December 23: Leucocytes 24,200. Operation: Median incision. Stomach found contracted, vessels on its surface engorged, many enlarged bright-red lymph-glands in lesser omentum, a few in greater omentum. The palpable tumor was the thickened posterior wall of the stomach, but the anterior wall was also somewhat thickened in the region of the pyloric antrum. Lesser peritoneal cavity free, no adhesions, but posterior wall of stomach was covered with fibrin. The stomach after washing was opened. The posterior wall was the seat of an enormous ulcer. The distal three-fourths of the stomach was then removed, the section being made well beyond the line of palpable induration and apparently in normal tissue. Union with the duodenum, which was long, as in Billroth gastrectomy No. 1. The operation, which lasted nearly two hours, was well borne; pulse was under 110 when patient left the table.

December 24: Pulse gradually rose to 140 in the afternoon without rise in temperature; patient was given fluids by rectum. The condition gradually improved till December 27. Patient was then allowed water by mouth. Temperature 99, pulse 120 to 130, respiration 30.

December 30: Tumefaction beneath suture line; stitches removed.

December 31: Great amount of seepage, stomach evidently perforated, no peritonitis.

January 2: Several sloughs of stomach wall came away through the open incision. Patient fed by catheter passed down duodenum, digestive fluids regurgitated into wound.

January 7: Severe hemorrhage from region of pancreas, repeated in the night.

January 8: Patient died, seventeenth day after operation and twenty-eighth after onset of inflammatory symptoms.

The pathologist, Dr. Ophuls, reported on the excised portion of the stomach as follows:

> Large flat ulcer with fairly clean, smooth floor and indurated base. Edges elevated and infiltrated with soft, greyish tumor which extends near to the edge of the specimen and in one place apparently beyond. In the tissue at the base and along the margin of the ulcer there are many bright yellow miliary abscesses. The tumor is typical adenocarcinoma.

Commenting on this case, I would say that it was much less fulminating in its development than most such cases, perhaps because of the resistance offered to the dissemination of the streptococci by the contracting stroma of the tumor. I believe the prognosis would have been better had total gastrectomy been performed instead of so extensive a partial gastrectomy, this because of the difficulty of defining the limits of the carcinoma and of the cellulitis, especially also because the duodenum was long and would readily have reached the cardia. Culture should have been made.

CASE II.—Stanford Service in San Francisco Hospital. *Acute hemorrhagic ulcer with cellulitis.* Man fifty-four years old, white, single, brought to hospital August 29, 1916, vomiting blood; temperature 101.2, pulse 84, respiration 20, apparently in desperate condition; able to give but a meagre history. Heavy drinker for years; drank mostly beer, less during last year. Digestion good until within one month, when he began to have occasional burning pain in abdomen; vomited occasionally; lost 25 pounds in weight; for the last week vomited blood frequently, and rapidly became weak and short of breath. No food retained during last two days; taking food seemed to have no effect on the burning pain. Blood-pressure 150–100 mm.

August 30: Vomited large quantity of blood in early morning. Blood-pressure 100–80, hæmoglobin 60 per cent., leucocytes 31,000. Abdomen tender all over, most in upper right quadrant. Diagnosis, acute ulcer of stomach with peritonitis.

Operation.—Nitrous oxide, a little ether. Midline incision in epigastrium, indurated, inflamed area 6 cm. in diameter in greater curvature, hypodermic needle brought pus from thickened area, resection of distal half of stomach, posterior gastro-enterostomy. Duration of operation, one hour and a half; patient very weak, salt solution under skin, camphorated oil, etc. Death four hours after operation.

Dr. Ophuls described lesion in excised portion of stomach as hemorrhagic necrosis of stomach wall 3 cm. in diameter, surrounded by phlegmonous inflammation; smear showed few diplococci, Gram +, culture, pure growth of streptococci.

Autopsy findings chiefly negative as bearing on the etiology of the gastric phlegmon, small amount of bloody fluid in right pleura, terminal bronchopneumonia. Tonsils atrophic, but smears from them showed many Gram + diplococci and other bacteria, cultures many diplostreptococci and few of staphylococcus aureus. Heart valves showed no bacteria; lungs, long chains of streptococci.

CASE III.—*Diffuse fulminating phlegmon following sore throat.* Seen with Dr. Adler.

Woman aged forty, single, domestic, strong, hearty, hard working, general health good save only for an occasional bilious attack, which led her to take a great deal of Pluto water.

December 22, 1916: Caught cold, took a dose of aspirin.

December 26: Not feeling well, took castor oil, vomited, and then had great abdominal pain; the bowels moved.

December 27: Vomited all day. Enema brought little result.

December 28: Tried to go to work, but soon had to give up; then consulted the physician. Temperature 99. Vomited several times, unable to take food. Shortly after noon had severe pain exactly in the midline, not radiating, epigastrium soon becoming tender, a little cough, especially on taking deep breath. Complained of feeling very tired, slight cyanosis.

4.30 P.M.: Temperature 102.6, respiration 36, leucocytes 10,200, polymorphonuclears 98 per cent. Slight resistance in epigastrium, borborygmus absent, sticky râles at bases of both lungs.

8.00 P.M.: Cyanosis slightly increased. Patient said she felt better, but apparently the process in the bases of the lungs had increased. Tenderness pronounced and sharply localized in midline below xiphoid, occasional hiccough, pulse 100 to 110. Blood-pressure 110, leucocytes 14,700, polymorphonuclears 98 per cent. Urine dark, nearly solid on boiling.

Diagnosis lay between basal pneumonia, acute pancreatitis, and gastric phlegmon. The process in the lungs was bilateral and did not seem extensive enough or pronounced enough to account for the great prostration or the local tenderness, and pancreatitis in cases with such prostration is apt to give a higher leucocytosis with less fever.

Exploratory operation: Midline incision under local anæsthetic showed considerable free fluid in the peritoneum, stomach thick, feeling like a great slab of liver an inch thick. Patient complaining of pain, was given a little gas and oxygen and ether; incision enlarged, stomach seen deeply congested, thickened from pylorus to cardia, lymph-glands in omentum large and red, much fibrin on anterior wall of stomach near cardiac end. The posterior surface of the stomach presented the same picture. A hypodermic needle brought muddy pus from the stomach wall, incision showed the muscle thick and œdematous, submucous connective tissue much thickened, necrotic and full of pus. Stomach opened. Interior was fiery red. A small portion of stomach wall was excised for examination. Stomach showed no power of contraction; it felt inert, heavy, lifeless. Multiple drains were inserted and the wound closed. Cultures and smears showed streptococci in pure culture. Death twenty-four hours later.

Autopsy one hour after death. No microscopic evidence of peritonitis, but smears from areas near the stomach showed streptococci; no bacteria in smears from cut surfaces of liver, spleen, kidney, or pancreas. The inflammatory process (swelling and suppuration) of the stomach wall was sharply limited at the pylorus and at the cardia; pancreas normal; lungs showed simple congestion at the base; liver, a moderate degree of fatty degeneration; kidneys, a few areas of cellular infiltration in the cortex.

When the stomach was laid open careful search failed to show any discoverable lesion of the mucous membrane.

A METHOD OF GASTRO-ENTEROSTOMY

By Francis T. Stewart
of Philadelphia

If there are signs of gastric retention the stomach is emptied by lavage shortly before the operation.

The posterior wall of the stomach is exposed, as in the ordinary operation of retrocolic gastro-enterostomy, by tearing through the mesocolon. A celluloid suture is passed through the posterior wall of the stomach at or near the greater curvature, and through the antimesenteric border of the jejunum several inches from the duodenojejunal juncture. Upward traction on this suture causes the stomach and the intestine to fall together. A second suture then unites the apposed viscera at a point two inches from the original suture, *i.e.*, two inches nearer the duodenojejunal juncture. The distance between the sutures may, of course, be less or greater according to the judgment of the surgeon. The first suture is drawn towards the patient's shoulder, the second towards the patient's right hip, thus lifting the parts to be anastomosed from the abdomen and bringing them into taut alignment. These sutures may be confided to an assistant or kept tense by attaching to each a pair of heavy forceps. The line of contact between the stomach and the intestine is now made permanent by a continuous seroserous suture, extending from the lower guide suture to the upper guide suture, and tied at the latter point, the end, however, being left long for use during the final step in the anastomosis (Fig. 1).

After shielding the general peritoneal cavity from contamination by means of an encircling gauze pad, the peritoneal coat of the stomach is incised close to and parallel with the line of suture, thus exposing the blood-vessels which, with a small bite of the underlying mucous membrane, as yet unopened, are secured with hæmostats at each edge of the incision (Fig. 2). The number of hæmostats required varies with the length of the incision and the vascularity of the part. The average is from five to six on each side of the incision. A smaller number is shown in the illustration for the purpose of clarity. The mucosa is incised between the rows of forceps, thus opening the stomach. Additional hæmostats may be needed to control minute vessels which could not be seen before the incision into the stomach was made. A gauze pad is laid over the gastric incision, and the row of forceps nearer the intestine reflected on to the gauze. In the same way as in dealing with the stomach the outer coat of the intestine is incised, the vessels caught with hæmostats (Fig. 3), the mucosa opened, and the opening covered with a gauze pad. This leaves the posterior wound edges exposed.

Each pair of vessels (one gastric vessel, one intestinal vessel) in these

* Read before the American Surgical Association, June 1, 1917.

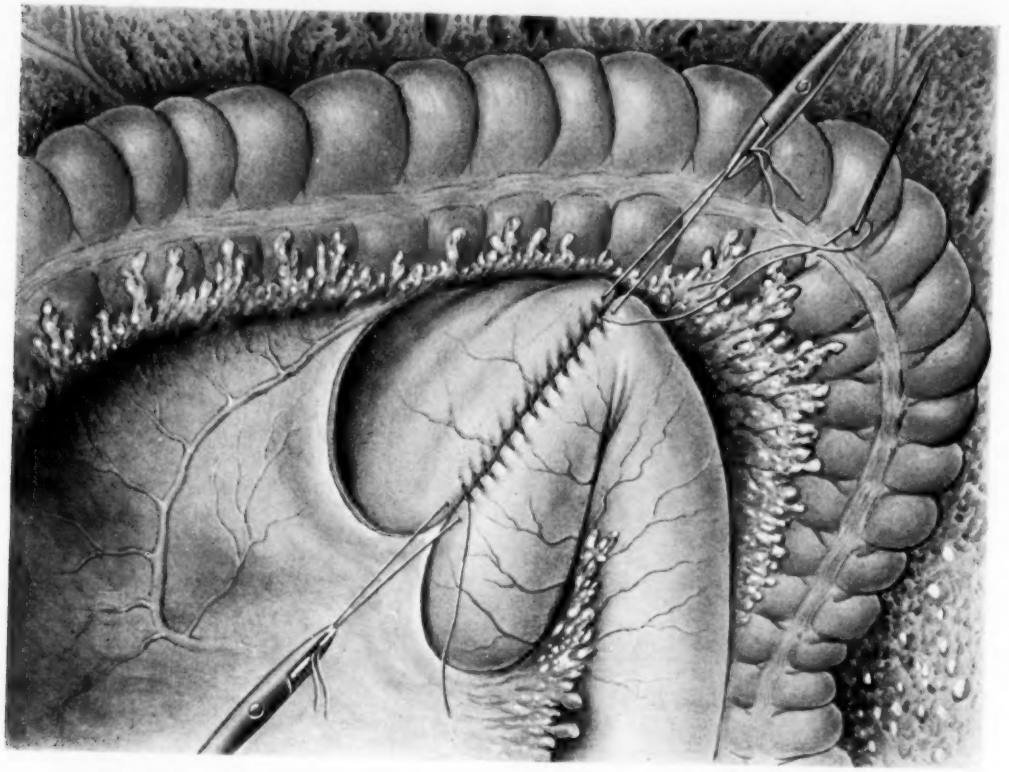

FIG. 1.—Gastro-enterostomy, showing the two guide sutures and the primary seroserous suture.

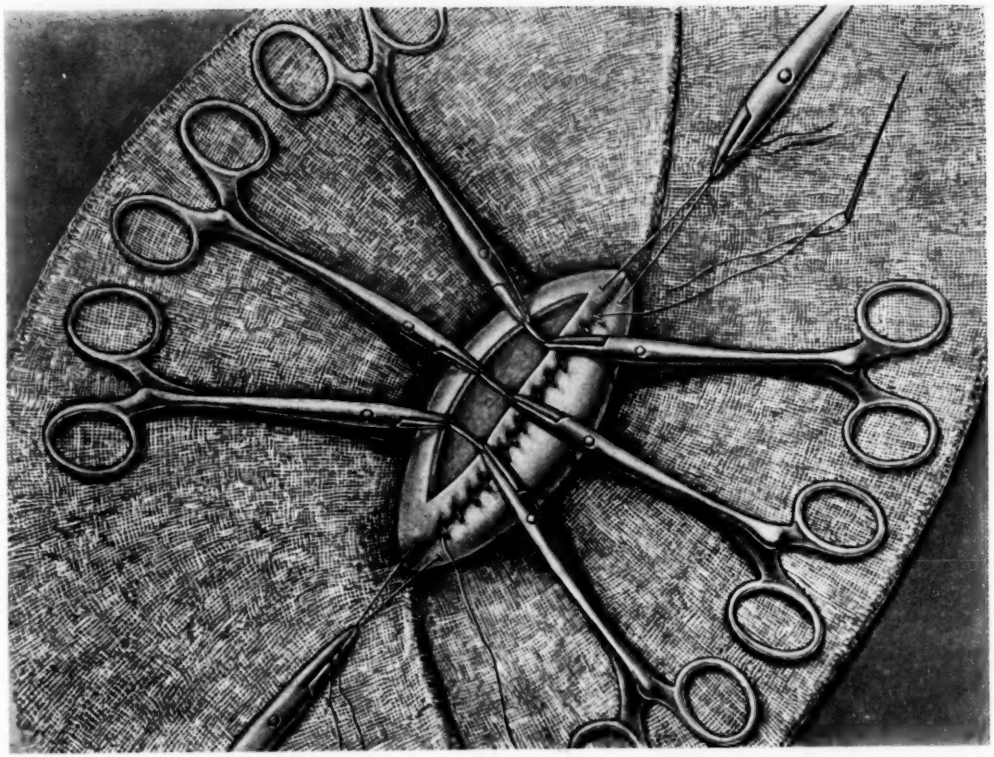

FIG. 2.—Gastro-enterostomy, showing forceps applied to the gastric vessels.

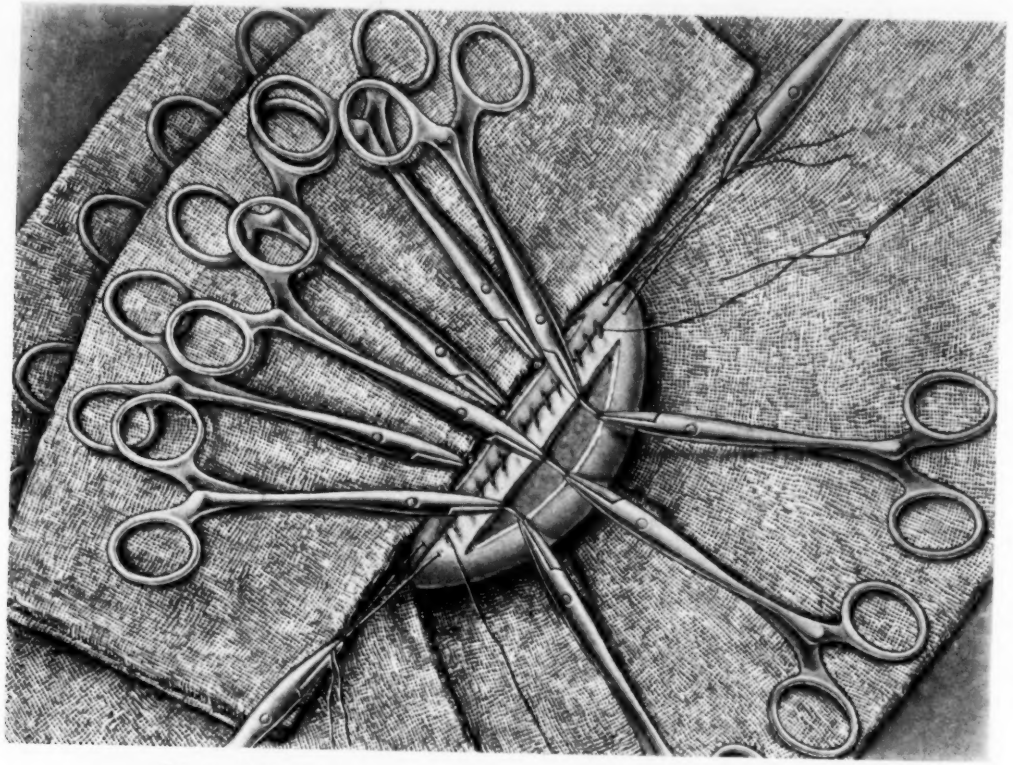

FIG 3.—Gastro-enterostomy, showing forceps applied to the intestinal vessels.

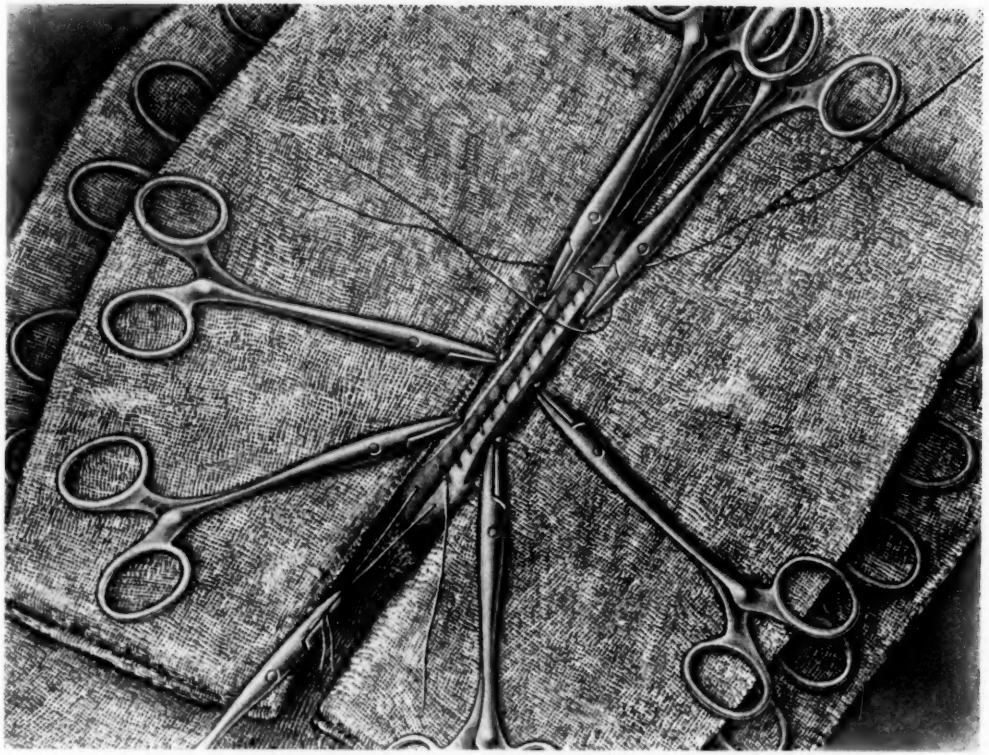

FIG. 4.—Gastro-enterostomy, showing the method of ligating the posterior vessels and wound edges.

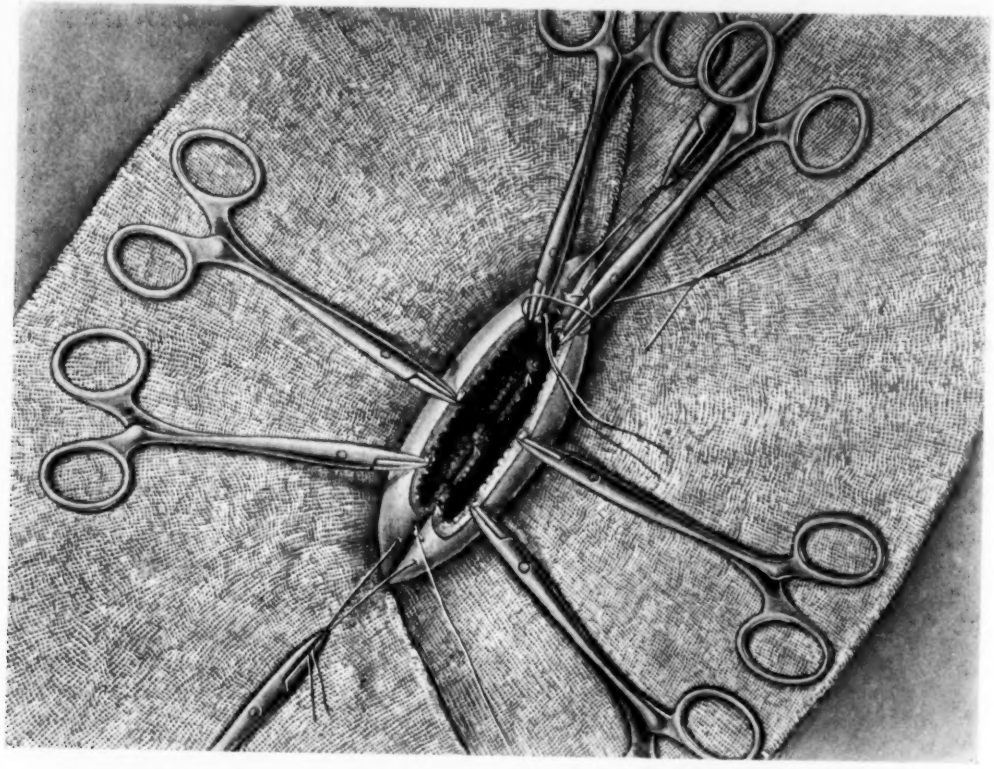

FIG. 5.—Gastro-enterostomy, showing the method of ligating the anterior vessels and wound edges.

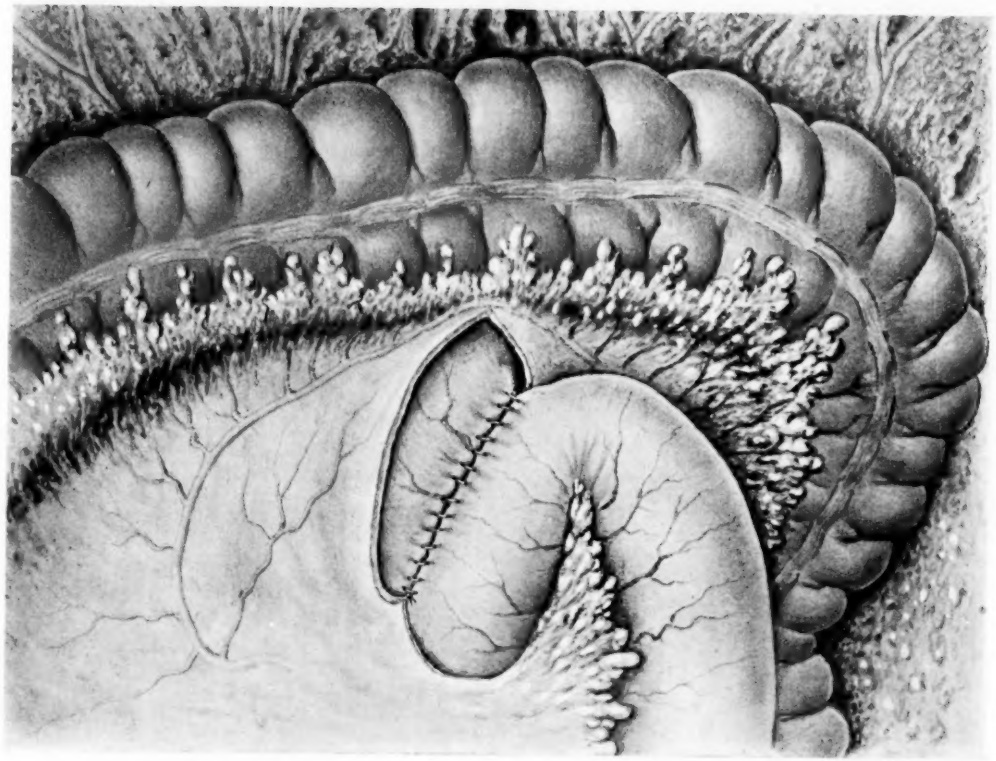

FIG. 6.—Gastro-enterostomy; operation completed by the anterior seroserous suture.

exposed edges is ligated with a single strand of chromicized catgut, after drawing the edges together by means of the two forceps (one on the stomach, one on the intestine) in closest proximity (Fig. 4). These ligatures not only prevent bleeding but also hold the edges in firm apposition. If a hæmostat does not stand in close relationship with a fellow, an additional forceps may be employed to establish this relationship.

After removing the gauze pads which lay over the gastric and the intestinal openings the anterior edges of these openings are drawn together by ligatures, beginning at the end farthest from the surgeon. The two forceps which lie opposite each other are held by an assistant. The right end of the ligature is passed around the forceps on the intestine from right to left, the left end around the forceps on the stomach from left to right; thus the ends emerge between the forceps, beneath the loop of ligature (Fig. 5). The forceps are brought parallel to the long axis of the wound, rolled toward each other, thus inverting the mucous edges of the wound, the ligature tied, and the forceps removed. Each succeeding pair of vessels is dealt with in a similar manner. The result is the same as with the posterior wound edges, *i.e.,* hæmostasis is assured and the edges are bound firmly together.

The rest of the proceeding is much like that usually followed. The seroserous suture is continued along the anterior portion of the anastomosis and tied at its point of origin (Fig. 6). The margins of the rent in the mesocolon are fastened to the stomach or the intestine.

The operation described above is easier to perform and less dangerous than gastro-enterostomy in which clamps are employed.

After the first guide suture has been inserted the structures to be joined are already in juxtaposition and there is no risk, even for the beginner, of confusing the relations of the parts, such as is possible during the application of clamps and their subsequent adjustment. Among the unreported disasters following gastro-enterostomy there are no doubt some which, thanks to inexperience and clamps, result from suturing the lower end of the intestinal opening to the upper end of the gastric opening. One of the stated advantages of clamps is that they steady and hold together the concerned viscera. As a matter of fact the stomach and the intestine are necessarily separated by the intervening blades of these instruments, whereas guide sutures not only permit direct apposition but at the same time create a ridge at the line of contact which facilitates suturing. The same degree of close alignment is obtained for the anterior seroserous suture, after the anterior wound edges have been inverted by ligatures. When clamps are employed the mucous membrane pouts, being squeezed out by pressure, and is usually excised. This excision is not needed in the operation without clamps. Suturing of the anterior edges of the mucous membrane, even after the clamps have been rotated toward each other, is more difficult than the application of ligatures as described above. Further, one draws less stomach and less intestine from the abdomen

when using guide sutures instead of clamps, or, to put it in other words, a longer anastomosis can be made with the aid of guide sutures than can be made with the same amount of stomach and intestine when clamps are employed, a consideration which occasionally is of some importance.

The danger of leakage of gastric or intestinal contents during the operation is no greater, perhaps even less, than when clamps are applied. Contusion or crushing of the tissues in the immediate vicinity of the anastomosis is avoided. Damage of this nature is potent for evil, especially in the old, the arteriosclerotic, the cachectic. The possibility of clamp injury predisposing to peptic ulcer of the jejunum, or causing necrosis at the site of anastomosis, although remote, is nevertheless real, and must be included in the evidence against the clamp. The greatest menace, however, is that of bleeding after the clamps have been removed. Like a tourniquet, the clamp increases the tendency to oozing of blood, after the removal of the compression, and when clamps are employed in gastro-enterostomy the hemorrhage, if all the severed vessels have not been closed, remains undiscovered until the patient vomits the blood or presents evidences of acute anæmia. One is then confronted with the alternative of waiting hopefully, or of reopening the abdomen, during a critical period, in order to arrest the bleeding. Even carefully applied sutures are uncertain, so far as hæmostasis is concerned, unless the wound is inspected after the clamps have been removed, since even large blood-vessels, unseen because empty, may readily be punctured by the needle. In the operation reported in this paper the surgeon ties all the open blood-vessels, and may assure himself that hæmostasis is complete. Of the 40 patients upon whom this operation was performed 38 recovered without mishap. Two, both afflicted with inoperable carcinoma of the stomach, died of exhaustion and pneumonia, one on the sixth and one on the seventh day.

A SIMPLE METHOD OF RESECTING THE TRANSVERSE COLON

WITH PRESERVATION OF THE OMENTUM: LIKEWISE FOR THE SUSPENSION OF A PROLAPSED COLON*

By John E. Summers, M.D.
of Omaha, Nebr.

It is not the purpose of this paper to presume to offer anything original, but rather to emphasize the value of a procedure apparently too little appreciated by surgeons, if one is to judge from observations of their clinical work, and from journal and text-book publications.

Resection of the transverse colon when done for other than malignant diseases, as for example, redundancy and ptosis, sacrifices the omentum, thus leaving uncovered peritoneal surfaces, difficult to protect without disturbing relations of viscera which had better be left alone. I am familiar with the work of Lardennois and Okinczyc and its still further elaboration by Pauchet, in which they make use of the clinical fact that the omentum can be easily and safely separated from the transverse colon and its mesentery up to the lower border of the stomach, widely opening the lesser cavity of the peritoneum if desired. Thus, all of the posterior wall of the stomach, that also of the first part, and of the upper portion of the second part of the duodenum is exposed: the pancreas is also exposed. Prof. Pauchet published a most interesting illustrated article in *Bulletins et mémoires de la Société de Chirurgie de Paris,* May 10, 1916. An excellent and favorable criticism and reproduction of this was published last fall by Dr. Sherwood-Dunn of Paris, in the *American Journal of Surgery.* The technic admits of ready exposure and surgical intervention upon all of the parts exposed when they may be the seat of trauma or disease. The separation of the omentum from the transverse colon and the transverse mesocolon depends upon the anatomical arrangement and relationship of the peritoneum. A bloodless, loose, and what I designate a *peritoneal ligament,* is formed along the upper border of the transverse colon by the juncture of the layer of peritoneum covering the stomach anteriorly and the omentum both anteriorly and posteriorly, with that enveloping the transverse colon: the latter goes posteriorly to cover the transverse mesocolon,—anteriorly forming the posterior layer of the lesser peritoneal cavity, spreading out below into the posterior layer of the greater peritoneal sac. The technic of resection of the transverse colon advocated is carried out after an X-ray study of the relative positions of the hollow viscera. A liberal incision having been made, the bowel is delivered and made taut by assistants. The operator lifts up the omentum with one hand sufficiently to recognize the line of juncture of its under surface with the upper surface of the colon. With a sharp pointed knife (a straight bistoury preferably) the peritoneum is nicked along this ligamentous line to the desired extent of resection. With a gauze sponge

* Read before the American Surgical Association, May 31, 1917.

the omentum is freed upwards from the transverse mesocolon to the lower border of the stomach, exposing but not injuring the mesentery blood-vessels. The resection of the colon is then done in the usual manner, being facilitated by an accurate view *from above* of each blood-vessel in the mesentery. After the completion of the anastomosis, end to end, or lateral, the omentum is made to cover the line or lines of suture of the anastomosis in such a manner as indicated in the particular case, and otherwise to resume, as far as practicable, its protective position. My personal experience with this technic leads me to favorably recommend it in non-malignant disease. Lardennois makes a colectomy by first separating the omentum as I have described for resection of the transverse colon, then going to the left he divides the avascular suspensory peritoneal band (the suspensory splenic ligament), dividing then the outer peritoneum as is usually done in mobilization. Practically a like manipulation is done on the right side; the bowel being mobilized is resected in the usual way. Binnie's Operative Surgery is the only book in English in which there may be found a description of this excellent and safe operation of colectomy. In a number of instances during the past year I have employed a technic for the correction of prolapse of the transverse colon based upon the Lardennois-Okinczyc-Pauchet studies in clinical anatomy. None of the operations commonly advocated for this purpose have been satisfactory to me. What I am now doing seems to promise well,—there have been no ill after-effects. It consists in opening the lesser cavity of the peritoneum as described, suturing the transverse colon to the posterior wall of the stomach along the line of its greater curvature, thus practically placing the transverse colon in the lesser peritoneal cavity, then dropping the omentum forward. In several instances in which the hepatic flexure was not properly fixed by this technic, I have brought up a piece of omentum to the right of its detachment from the colon, and after ascertaining by upper and outward traction the proper position of the flexure, have sutured this omentum to the parietal peritoneum. This lifting of the hepatic flexure might be accomplished from behind by a retroperitoneal incision fastening the so-called nephrocolic ligament to the lumbar fascia. When the position of the stomach has appeared to require, I have in addition done a gastropexy.

Of course the few months' trial of this technic can to date only be suggestive.

CARCINOMA OF THE SPLENIC FLEXURE OF THE COLON*

By John A. Hartwell, M.D.
of New York
SURGICAL DIRECTOR OF THE CORNELL UNIVERSITY SURGICAL DIVISION, BELLEVUE HOSPITAL

The problems presented by six cases of carcinoma of the splenic flexure of the colon or its immediate proximity were so difficult of solution that the writer was led to make an extended study of the subject. The lack of success of many others in solving these problems coincides so exactly with his own, that it seems proper to ask the attention of the Association to them, in the hope that the discussion may yield some measure of improvement in dealing with them. While there is found some encouragement in the literature, the complete story shows that cancer at the splenic flexure has proved to be a peculiarly fatal lesion. The record of the six cases observed is as follows:

Case I.—J. C., male, age twenty-seven, admitted to the hospital May 6, 1913, suffering from a well-developed intestinal obstruction of six days' duration. The pain seemed to centre in the right lower quadrant. The only cause worthy of consideration from a study of the history and the abdominal examination, was that of constricting bands at the cæcum, as a sequela to an interval appendectomy, done two years previously. An incision was made over the cæcal region. A band passed across the cæcum from the omentum outward to the abdominal wall, and the pressure exerted had been so extreme, that the entire caput coli had sloughed away. The ileocæcal orifice presented. The peritoneum contained several quarts of fluid fæces. This was thoroughly washed out, and the cæcum drawn into the wound by stitching the free edges to the peritoneum and skin. Recovery was unexpected, but gradually took place. Many weeks had to be spent in getting the patient into condition to deal with the open cæcum. When this was undertaken, it was discovered that the true cause of the intestinal obstruction was a constricting cancer, just distal to the splenic flexure, and the band across the cæcum was secondarily responsible for its destruction. A lateral ileosigmoidostomy was done, with an excision of the cæcum and the ascending colon, the free ends of the bowel being closed. The patient steadily gained after this operation, and four months later the cancer with the remaining portion of the colon was removed. It was noted that the closed end of the sigmoid, proximal to the anastomosis, had developed a well-marked cæcal pouch. When last seen, nearly two years later, he was dying of general peritoneal carcinosis.

The study of the tumor showed it to be a mixed scirrhus and colloid carcinoma. The growth completely surrounded the colon, and closed

* Read before the American Surgical Association, May 31, 1917.

its lumen. At one point there was a perforation in the base of an indurated villous-like ulcer, but no abscess had developed.

CASE II.—E. B., female, age thirty-five, admitted to the hospital July 17, 1913. Twelve years earlier she had had a double oophorectomy for excessive dysmenorrhœa. She remained well for eight years. Then she began to suffer from abdominal pain, of a recurrent type, which seemed to centre about the cæcum. A diagnosis of chronic appendicitis was made, though a late manifestation of peritoneal adhesions was considered. The attacks were very infrequent, and not severe enough to call for operation until a week or two before admission to the hospital. From that time, however, they had progressed markedly, and nausea with vomiting was present.

At the time of admission, the patient was at the height of an attack, and demanded immediate operation because the pain had grown so severe in the preceding twelve hours. The physical examination gave no farther evidence of the seat of the trouble than could be obtained from pain and tenderness over the cæcum. A median laparotomy was done, because of the doubtful diagnosis. A slightly inflamed appendix was removed. Exploration revealed a hard encircling cancer just beyond the splenic flexure. There was no anatomical evidence of complete obstruction. The proximal transverse colon had, however, become adherent to the descending colon, immediately distal to the tumor; nature's attempt to overcome the impending obstruction. The growth with its adjacent colon was resected, and an end-to-end anastomosis done. This was difficult because of tension on the intestine. Drainage was established through a counteropening in the flank. Death occurred on the fifth day. Autopsy disclosed an abscess in the omentum which had been placed around the suture line as a barrier.

The tumor encircled the colon, embracing all its coats. Within the narrowed bowel was a cauliflower mass which left a lumen of only 3 mm. The microscopical section showed the tumor to be adenocarcinoma. The cauliflower mass classes it with the encephaloid group.

These two cases illustrate a condition which is several times described in the literature, in which the symptoms centre about the cæcum, rather than the site of the lesion.

Passot (quoted by Veaudeau) reports a case very similar to the first.

CASE III.—W. B., male, age forty-seven, admitted to the hospital December 6, 1916. A history of recurrent diarrhœa, extending over many years—"all his life"—was obtained. Constipation had never been present. For two years he had suffered from indefinite symptoms described as indigestion. During recent months he had noticed blood and mucus in the stools. (This fact was only learned after operation.) In the fall of 1916 he was under treatment for the gastric symptoms, and received gastric lavage. During this procedure, late in November, he was seized with moderately severe pain at the left costal margin. This had recurred intermittently since then. He now refers it to a region beneath the lower ribs, from the midclavicular line backward nearly to the spine. Gradually the pain has become a constant dull

ache, which is increased on any deep respiratory movement. It is also rendered more severe by a full stomach. Examination on admission showed the patient to be moderately ill. The temperature varied between 98° and 102°. The leucocyte count was 14,000, with 78 per cent. polynuclear cells. There existed all the signs of a left subdiaphragmatic abscess, and the tentative diagnosis of a subacute perforation of a gastric ulcer near the cardia was made.

At operation a curved subcostal incision was carried from the midaxillary line forward, and later enlarged by dividing the rectus muscle. On gaining entrance to the peritoneum, a large abscess was encountered containing many ounces of foul-smelling pus. Only after very considerable difficulty in separating the matted omentum from the stomach and the transverse colon in front, the spleen and the kidney behind, and the diaphragm above, was the cause of the condition discovered. A cancer of the splenic flexure, with perforation, was present. The tumor and adjoining colon were mobilized without difficulty, and the entire diseased portion, with a sufficient margin of healthy bowel on either side, brought outside of the abdomen. The Mikulicz procedure was attempted, but could not be accomplished because the proximal and distal portions could not be brought sufficiently in apposition. The required amount of bowel was therefore excised, and a tube placed in the open ends, held within a constricting purse-string (Paul's operation). The two ends were then placed in approximation and the afferent and efferent arms sutured. The greater part of the wound was closed, a gauze packing and tube drainage being placed in the bed of the diaphragm to control hemorrhage, which was rather severe.

An error was made in attempting to place the two arms of the gut in approximation. This resulted in too great tension, so that retraction occurred, and the fecal discharge from the proximal end could not be prevented from constantly reinfecting the subdiaphragmatic space. A counterdrainage was resorted to, as the result of which, an empyema developed. The original abscess cavity became clean, and a well-functionating artificial anus was established. A rib resection to control the empyema failed of its purpose, and the patient died from chronic sepsis, six weeks after the first operation.

Examination of the excised lesion showed it to be carcinoma with thick strands of cellular fibrous tissue; the scirrhus type. It involved the entire circumference of the bowel, infiltrating all the coats. A minimal lumen remained. The base of the cancer was ulcerated with overhanging edges. Its longitudinal extent was less than one inch. A perforation about one-third inch in diameter was present. A lymph-node found in the mesentery of the excised bowel showed no carcinoma.

In view of the complicating abscess and the impossibility of properly protecting it from fecal drainage, a better plan than the one followed could have been devised. A cæcostomy, with large siphon drainage, and the eventration of the involved colon, with closure of the peritoneum around it for later resection, would have given opportunity to deal with the abscess cavity. The reëstablishment of the colonic tract could then have been dealt with at leisure.

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An example (Schwab's case) of perforation of a similar tumor, with subdiaphragmatic abscess, is reported by Madelung. Hutchinson and Walbock report a similar case. (See case reports.)

CASE IV.—L. F., female, age forty-two, admitted to the hospital April 8, 1916. For two years she had suffered from pyrosis, which was relieved by sodium bicarbonate. For one month pain in the left abdomen and lumbar regions had been present. It was of a dull aching character. No history of any disturbance of the bowels or blood in the stools could be obtained. A complete intestinal obstruction had developed five days prior to admission. There was nothing found on physical examination to determine the cause of the obstruction because the marked abdominal distention obscured all else. Through a median suprapubic incision it was found to lie in an annular constriction at the splenic flexure. The cæcum was distended to the bursting point. The median wound was closed and a cæcostomy performed, with tube drainage through an intermuscular appendix incision. Recovery was satisfactory, the cæcostomy functionating well. The radical removal of the tumor was done 19 days later. Through a transverse incision, the tumor, which lay two or three inches below the apex of the flexure, was thoroughly mobilized in the usual way, and the bowel, from the sigmoid to above the flexure resected, Payr clamps and the cautery being used. The ends were closed by chromic gut ligation, immediately behind the clamps, and the ligated ends inverted inside a double row of linen sutures, the first as a purse-string, and the second an over-and-over Lembert suture. A lateral anastomosis was then done between the transverse colon and the sigmoid, the usual type of chromic and linen sutures being employed. In order to obtain sufficient mobilization it was necessary to place the stoma in the transverse colon, about 5 inches proximal to the flexure, thus leaving a blind pouch of this length distal to the anastomotic opening. The abdominal wound was closed to its outer portion, where the bowel ends and the anastomosis could be placed practically extraperitoneally. Drains were placed so as to avoid contact with the suture lines in the intestines. The cæcostomy was not disturbed, it being desired to have this as an outlet in case of any tendency to overdistention. For one week the convalescence was perfectly smooth. The cæcostomy functionated and there was no distention. On that day there appeared a slight fecal discharge from the drainage wound, but the peritoneum did not seem infected. The following day, however, the patient showed signs of sudden collapse, began to vomit persistently, without distention or other evidence of peritonitis, and died in a few hours, in spite of gastric lavage and other attempted remedies. No autopsy was obtained. The actual cause of death remains in doubt because there was absence of signs of peritonitis or local abscess, and in some points the symptoms suggested a pulmonary embolism. For the reasons discussed in operative technic a greater length of colon should have been resected. The tumor proved to be an annular growth, one inch and a half in longitudinal extent. It caused a nearly complete obstruction of the lumen. Microscopically the growth was of the infiltrating type, all the walls being in-

volved, and it corresponded more nearly to the scirrhus type than the colloid or the encephaloid.

CASE V.—F. S., male, age fifty, admitted June 27, 1916. The history showed that there had been well-marked evidence of the true condition for fully two years. There existed a disturbed condition of the bowels, with diarrhœa and constipation. On several occasions blood had appeared in the stools. For six months he had suffered from very evident attacks of partial obstruction, followed by periods of diarrhœa. These had progressively grown more severe and frequent. On admission he was suffering a complete obstruction of at least three days' duration. Abdominal examination showed the colon as far as the splenic flexure enormously dilated, and not apparently so beyond this. The patient was a marked alcoholic and suffered from advanced myocardial and kidney lesions so that any extended operation was impossible.

A cæcostomy was performed, and functionated satisfactorily. On July 20th his condition was sufficiently good to justify an attempt at an anastomosis around the obstruction, which could now be palpated as a large fixed tumor at the splenic flexure. Through a median incision a lateral anastomosis, without exclusion, was done between the lower ileum and the descending colon. Examination of the tumor showed it to be a large nodular neoplasm involving the entire splenic flexure, and adherent to the posterior parietes. Hard, enlarged lymph-nodes were palpable in the mesentery. Its excision was impracticable because of the technical difficulties, and the very poor operative risk presented by the patient.

The fecal current gradually found its way through the anastomotic stoma, and the cæcostomy closed in about a month. The farther course was satisfactory until on a very hot day he overworked, and indulged in excessive eating. This resulted in an acute attack of vomiting and a marked retention of fecal matter in the ascending and transverse colon. This was relieved by opening the cæcostomy and inserting a tube. He gradually recovered and there was only moderate discharge from the artificial opening. The same condition recurred, however. In spite of free drainage through the cæcostomy he rapidly lost strength, and died about ten weeks after the original operation.

No autopsy was obtained. The diagnosis is not, therefore, microscopically confirmed, but operative palpation and inspection presented all the characteristics of carcinoma.

CASE VI.—Only clinical evidence exists for the diagnosis of carcinoma in this case. The patient is a woman, seventy-six years of age, who was first seen on January 17, 1917, with a well-developed and practically complete attack of intestinal obstruction. The pain was very severe, and was localized by the patient in the left hypochondrium. A history was obtained showing that there had been two or three previous attacks of a similar nature during the preceding six months. They had been progressive in severity and frequency. The last one about five weeks earlier had been nearly complete. It had been accompanied by the passage of blood in the stool. Her physician diagnosed

cancer of the colon at that time. By the use of morphine, turpentine stupes, repeated enemata, and colon irrigations the condition was again relieved at the end of one week. The patient still remains in comparative health, and by the free use of mineral oil, colon irrigations and great care in diet, has been able to avoid any further attack. Her age and general condition precludes urging operation, to which her family is strongly opposed. The abdomen is now relaxed, and a hard, non-movable tumor is palpable in the region of the splenic flexure. There can be little doubt of the diagnosis in this case. A chronic inflammatory lesion, such as a diverticulitis, is a possibility, but the freedom from pain when obstruction is not present is opposed to this, as is the occurrence of obstruction without evidence of an abscess. (Cf. Castaigne's Case, p. 38b.).

These six cases illustrate in every phase the characteristics of the cases found in the literature. Their further discussion may, therefore, be postponed until a review of other reports has been presented. For the earlier reports we shall draw largely on Madelung's paper in 1906, which includes 93 cases from the literature and 7 of his own.

Histologically, cancer of the splenic flexure differs in no way from cancer in other parts of the large intestine. The growth in all cases originates in the mucosa, probably from the cells in the crypts, and it is governed by the same unknown factors which obtain elsewhere. Paul's classification into the scirrhus, the colloid, and the encephaloid offers a good descriptive basis, but it must be remembered that these terms are applicable to differences in appearance rather than in essential characteristics. Undoubtedly there exist determining factors which, did we but comprehend them, would help us in explaining why a malignant neoplasm arising from a constant shows such marked variation in its growth. The variations are those found in cancer generally, and therefore cannot be ascribed to any influence exerted by the location in an infectious area. One exception may exist to this generalization. The colonic growths are prone to ulceration and perforation. The bacterial action of the intestinal content may conceivably have some bearing on this complication. The three varieties are not clear cut, and often the same growth shows characteristics of more than one type, as illustrated in Case I, here reported, where a hard annular scirrhus tumor showed colloid degeneration, and a central perforation, and Case III where the scirrhus and encephaloid were combined.

Paul's statement that the encephaloid is the most common and the least malignant is borne out by other reporters, though unfortunately little pathological detail is given in most cases. This type grows more bulkily into the lumen of the intestine, and has less infiltrating power than the other types. It approaches more nearly, or differs less, from the benign polypo adenoma than the others. Enlarged lymph-nodes are usually present in the mesentery, but they are often not invaded by cancer, being simply hyperplastic from infective irritation.

The colloid type stands at the head of the list, so far as malignancy is concerned, but fortunately is the least frequent. It tends to local ulceration, inside of a hard-edged circumscribed growth.

The scirrhus type, according to Paul's experience, stands midway between the other two, both in frequency and malignancy. The growth is slow and local. It is characterized by marked fibrosis. The lymph-nodes contain cancer elements. Recurrence following removal may occur at a comparatively late period.

Madelung, in his earlier analysis, arrived at the same conclusions as Paul. He, in addition, called attention to the comparative infrequency of distant metastasis. He found the liver involved only six times in 100 cases. In four instances a second growth was found in other parts of the alimentary canal, two of which, however, seemed to be independent growths, rather than metastases. In general, the reported cases confirm the comparative infrequency of distant metastases.

Huguier and Rigollot-Simonnot report a most interesting case in which cancer occurred in the left lobe of the liver. The symptoms were those of an acute abscess with high temperature and leucocyte count. Operation disclosed a cavity in the liver, a fragment of which showed carcinoma of intestinal origin. Only at autopsy was the primary growth found to be in the splenic flexure. From the description, the liver involvement was more a direct extension than a true metastasis.

Butlin (quoted by Madelung) finds that over 60 per cent. of patients suffering from colonic cancer die from obstruction or other complications before a serious metastasis occurs. While no extended statistics are at hand for cancer localized to the splenic flexure, this figure is probably low rather than high for this part of the colon.

Bockel and Swain (quoted by Madelung) report the successful removal of splenic flexure cancers in which cancerous nodes were removed. They believed that involved nodes remained, and yet the patients recovered and continued well over long periods.

Madelung, after a complete survey of the evidence, concludes that lymphatic involvement from splenic flexure cancer is not as frequent as from cancer of the cæcum and ascending colon. In our study we are confronted with the same difficulty that he encountered in the study of case reports. Often it is stated that enlarged nodes were present, but no microscopical report is included. The accurate location of the nodes is rarely given. Our conclusion, based on additional cases, coincides with that of Madelung, but we can give no figures to support it. One is justified in the belief that lymphatic and distant metastases are not a serious menace to successful treatment.

From the aspect of therapy, the pathological characteristics of these growths present points both favorable and unfavorable. Their rate of growth is not rapid. Therefore, their complete removal should be possible. This is more to be hoped for because of the slight tendency to lymphatic

and distant metastasis. But since the lesion is primarily a mucosal manifestation, the early growth is not accompanied by any serious disturbance of function, and pain is not a symptom. Considering the ulcerative character of the lesion, hemorrhage from the bowel should be expected. On the contrary, this is a comparatively rare occurrence. No statistical evidence can be adduced because the records are too incomplete, but absence of mention may be taken as negative evidence. It was present in three of our cases. Madelung mentions it in ten of one hundred reported cases. Its absence is certainly of no negative value, and its presence is easily overlooked, or, unfortunately, assigned to other causes.

While the localized nature of the lesion favors its removal, the anatomical relations of the splenic flexure present difficulties not found in other portions of the colon. These difficulties are further enhanced by reason of the fact that very often, as just explained, an early diagnosis is not made because the symptoms are not marked. It is only diagnosed when some secondary condition has arisen, such as serious adhesions, obstruction, or abscess formation, any one of which adds enormously to the gravity of the problem confronting the surgeon. These factors will be more fully discussed later.

The splenic flexure is apparently the third most common site of colonic cancer (exclusive of the rectum), the sigmoid loop and the cæcum being the sites of preference. The ascending, the transverse, and the descending colon proper, are comparatively immune. It is a matter of interest to note that the hepatic flexure is not as frequently attacked as the splenic flexure.

Madelung quotes the following autopsy statistics. Bloch reports four cases of splenic flexure carcinoma among 138 cases of colonic cancer. Lambret 8 cases among 237. DeBovis 21 cases among 426. A total of 33 cases of cancer of the splenic flexure in a series of 801 cases of cancer of the colon in general, exclusive of the rectum, *i.e.*, 4+ per cent.

The ratio of cases reported from clinical records by surgeons is essentially different. Madelung quotes the following: Clogg 6 cancers of splenic flexure in 25 cases of colonic cancer, Dollinger 1 in 25, Hartman 1 in 10, Hochenegg 2 in 7, Korte 7 in 54, Mikulicz 12 in 86, Rotter 2 in 34. A total of 31 cancers of the splenic flexure in 241 colonic cancers—12.8 per cent.

William J. Mayo, in the presentation of the Surgery of the Large Intestine before this Association in 1909, reported 61 cases of cancer of the colon, 7 of which were found in the transverse colon and its two flexures, but the exact distribution of these is not given. Cope reports finding 3 cases of splenic flexure cancer among 20 cases in the entire colon. Corner found the splenic flexure involved in 2 per cent. of the cases of colonic cancer occurring in St. Thomas' Hospital in 1910 and 1911. Veaudeau mentions one case in seven. Mumford found 16 cases among 48 in the Massachusetts General Hospital records covering 16 years. Rotter reports 8 cases in a study of 49 cases of colonic cancer.

It will be noted that the various autopsy reports run fairly constant,

the extremes being 3.3 per cent. and 4.9 per cent., while the clinical reports show a wide variation from 4 per cent. to a fraction less than 30 per cent. Undoubtedly the autopsy records are the more nearly correct, both because they include a greater number of cases, and because they are based on final observations and are not limited by the many factors which influence the cases coming to operation.

A search of the American, English, French and German literature since Madelung's report of 100 clinical cases in 1906, shows 57 to have been reported. Probably others are included in the general subject of colonic cancer and intestinal obstruction, but cannot be identified. Only four reports appear in the records of the New York Surgical Society (two more being mentioned but not recorded) during the last ten years, and none in those of the Philadelphia Academy of Surgery, as published in the ANNALS OF SURGERY. From these figures it is apparent that the condition is not a common one, and that even the surgeon of large experience can see only a comparatively small number. The rather discouraging results obtained may, to a certain extent, be due to the fact that a definite technic has not been established. The modes of attack differ markedly, and the successes do not seem to be entirely dependent upon any one procedure. Certain factors in the successes, however, stand out rather forcibly, which we shall discuss in detail later. As Veaudeau says, the statistics are very unsatisfactory, and a conclusion can be better drawn from general impressions than from an array of figures.

From a study of the symptoms it is apparent that in many instances symptoms are present over a long period which should lead to an early diagnosis. On the other hand, diagnosis is delayed in fully one-half of the cases until a serious acute complication is added to the original lesion. In part this is the result of lack of intelligence on the part of the patient, and a less excusable lack of education on the part of the medical profession. In part, however, it arises from the fact already mentioned, that these growths may occasion surprisingly little disturbance prior to the onset of the complicating lesion. If of the scirrhus type they grow as a mildly ulcerating annular extension around the bowel. The contraction of the fibrosis tends to a narrowing of the lumen. Bleeding is not a marked manifestation, and is not sufficient to attract attention in the stool. As is well known, the intestine itself is not especially susceptible to pain-producing stimuli unless the peritoneal coat is dragged upon. This coat is involved only as a late manifestation and in many cases remains almost intact until a perforation takes place. Pain, therefore, from the presence of the growth itself, does not occur, and is only instituted when a complicating lesion arises. All these factors are also present in the colloid type, and hence its early manifestation is obscure. In the encephaloid type, the growth is less annular and more a heaped-up mass of ulcerating carcinoma. Such evidence as the very meagre reports show, seems to indicate that this type is more prone to bleed than the others, but even here the amount is rarely excessive. In the six

cases here reported hemorrhage was present in three, and while the specimen was removed in only one of these, to prove it belonged to the encephaloid group, the evidence presented by the massive character of the others so places them. The question of progressive obstruction still remains to be considered as a factor in making an early diagnosis. This should be most apparent in the scirrhus and colloid groups, because of the tendency to a contracting fibrosis. The colonic content at the splenic flexure is still rather fluid than solid, hence, a very considerable constriction may take place before the fecal current is stopped. It may be retarded, but this gives rise to no localizing symptoms. It seeps through into the lower colon, the water is there absorbed, and the recto-sigmoid reservoir produces a normal formed stool. It is thus explained that the pencil stool, so graphically described as a symptom, does not occur. In fact this is absent even in constriction much lower down, sometimes within reach of the palpating finger per anum. Experimental evidence and clinical observation both emphasize the fact that the symptoms of intestinal obstruction do not arise until the closure of the constriction stops the passage of gas. Numerous specimens show a constriction only admitting the passage of a probe, which, however, had never produced obstruction until suddenly a complete acute occlusion supervened. Case II here reported illustrates the absence of obstruction with a lumen of ⅛ inch. Case IV showed a " minimal " lumen, but never had had symptoms previous to her admission with complete intestinal obstruction. Many patients trained to careful observation under the care of competent men are totally unaware that they are seriously ill until a sudden obstruction arises. The authors studied, place the proportion of cases of cancer of the colon presenting a complete obstruction as the first really diagnostic symptom at from 40 per cent. to 60 per cent. For the splenic flexure, this is probably low rather than high (*vide infra*). There is, however, one symptom which careful questioning may elicit in a minority of cases. The patient says true constipation is not present, but that even after what seems a normal evacuation of the bowel, there exists the desire for a further movement. The probable explanation of this is found in the fact that the colon above the stricture is a constantly filled reservoir, which continually feeds fecal matter into the lower bowel, so that the latter never has the normal rest to which it is entitled. It is rather surprising that colicky pains are not a more constant symptom. They are mentioned as being present in a goodly proportion of the cases, but often are not severe enough to be considered as significant. Case II illustrates this. If one examine the colon proximal to a constricting cancer, it is always hypertrophied, and sometimes dilated. This permits of its continually forcing its content through the constriction without undue peristalsis, and so long as it can avoid overdistention from gaseous content, there is no painful contraction present.

In 19 cases Madelung found a palpable tumor. In two of our cases this was true. While this does not make the diagnosis certain, it makes operation imperative when the exact condition will be disclosed.

It is thus manifest that cancer at the splenic flexure may progress to an

advanced stage without the development of any symptoms which could reasonably give rise to a suspicion of the serious lesion harbored. We may in such cases, exonerate both the patient and the medical profession from the blame attached to a delayed diagnosis. On the other hand, telltale symptoms *may* be present in a varying degree, and with careful study, ought to lead to the suspicion that cancer in or near the splenic flexure is present.

In the five operated cases here reported only one came to operative treatment prior to an acute complicating lesion which immediately threatened death. Even in this one (Case II) complete intestinal obstruction was forestalled only by a few hours. A study of the histories given, however, demonstrates that the data for a tentative diagnosis were present in three of the cases many weeks or months prior to the acute onset. The conclusion is inevitable that the importance of minor disturbances from the normal is not fully appreciated, and that the same campaign of education must be undertaken as is being done in the case of mammary cancer, uterine cancer, stomach cancer, etc. It is necessary to emphasize that the most common complication which supervenes to attract attention is intestinal obstruction of varying degree.

As previously pointed out, this is often absent until the lumen of the colon is closed to an astonishing degree. On the other hand, it may come about because of impaction, either of fæces or a foreign body, because of inflammatory swelling as the result of ulceration, or because of adhesions and kinking. These various conditions are probably responsible for those cases which show repeated attacks of almost complete obstruction, followed by a comparative recovery. Cases V and VI in our report are illustrations. Many patients are seen who have suffered such attacks over many months. Then an attack more resistent to treatment than previous ones develops. The condition is then needlessly serious. A patient suffering such attacks demands the most complete study, and failing a diagnosis, exploratory operation should not be postponed beyond the second attack. This teaching is sound, but is woefully neglected. Attack after attack is tided over by various measures. The final one is treated along the old lines with the deluded hope that once successful always successful, and failure only acknowledged when death is imminent. It is not a matter of wonder that under such conditions operative results are discouraging. The question really concerns that of exploratory operation, and is not so simple as the facts cited would indicate. Between the cases presenting almost no symptoms until an acute obstruction is at hand, and those showing the marked symptoms just discussed, there is a group in which symptoms are present, but in no way urgent. They frequently occur after manifest errors in diet, or when the digestion is disturbed by overfatigue and anxiety. They are indefinite, and vary considerably in their character. They in nowise differ from disturbances which have no gross lesion as their basis. The most careful examination by every method of diagnostic aid fails to do more than arouse a suspicion of a serious condition. To advise every patient under such circumstances to submit to an exploratory operation with its

attendant risk, suffering, financial burden and other disadvantages, is a satisfactory and sure method of learning the truth, but it is a severe method if the true condition be nothing calling for or helped by operation. This picture of the exploratory operation is not overdrawn if the patient be the draftsman. The risk is known by the surgeon to be minimal, the suffering often lasts only through the nausea induced by the anæsthetic, the financial burden can be fully controlled, and the anxiety can be dispelled by a tactful optimist. The fact remains, however, that an exploratory operation with negative findings is a serious undertaking, and one in which the conscientious surgeon is loath to have part. What then is the proper course in these cases of suspicious, but no positive symptoms? It is to be found in a much more thorough study than is usually given. In private practice the patient must be taken into one's confidence, and made to carefully study his own symptoms, without being alarmed. He must, on one pretext or another, be seen at intervals, even though in apparent health. A careful analysis of the symptoms must be tabulated. Do they persist after palpable errors in hygiene have been corrected? Is there a tendency for them to become gradually more insistent? Cannot some positive evidence, such as melena, a definite pain or tenderness, or the radiographic plate be made to give the needed clue which justifies insistence on an exploration? In hospital practice we can more completely control the patient while he is actually in the ward, and as a rule can carry out all needed study. Failing, however, of any positive findings, we have more difficulty in keeping him under observation over an extended period. The development of the social service bureau, the follow-up system, and a closer affiliation between the wards and the out-patient rooms, is improving our opportunities in this direction, and except in the most unintelligent and roving classes we are able to keep in touch with our cases.

Our justification for so fully discussing this phase of the subject lies in the fact that a large proportion of our failures in dealing with cancer of the splenic flexure is directly and solely assignable to the acute or subacute complication occurring before operation is undertaken. A greater measure of primary success can only come if we devise some means to do our surgery earlier. Even with the greatest care exploration must always have a valuable place.

The problem of the surgical interference in cancer of the splenic flexure presents certain distinct difficulties which do not exist in other parts of the colon. Surgically, it is inaccessible. If surrounded by an inflammatory zone, it becomes densely adherent to the stomach, near the cardia, the diaphragm, the kidney, the spleen or the pancreas. Case reports show that all of these may coexist. The colon at the flexure, and distal to it, is provided with no mesentery. A goodly portion of its circumference, therefore, has no serous covering. The immediately adjoining segments, on both the proximal and distal sides, are not mobile, so that approximation is difficult. The failures reported may, many of them, be explained because these difficulties were not overcome. (Compare Cases II and III.) Success lies in devising a

technic which will overcome them, and to this end a study of all the case reports collected has been made. Including Madelung's, there are 157 cases. Many of these fail to give sufficient operative detail to be of value, so that our study is based upon an analysis of 128 cases. As a conclusion of his studies, Madelung sums up:

An enterostomy (mostly a cæcostomy) was done 26 times, 24 times for complete obstruction. In only two cases was life appreciably lengthened.

Entero-enterostomy was done 12 times, 6 times in the presence of complete obstruction. One-half died immediately following operation. Of the other six, the greatest post-operative length of life reported was one year, though two were still living two and three months after the operation at the time of the report.

Enterostomy with entero-enterostomy were done 11 times, 8 times in the presence of complete obstruction. Life was prolonged in 8 of these, one living for three years and four months after operation, and one being in good health one year and three months after operation, at the time of the report. The other 6 lived for three and a half to fourteen months.

Resection was done 34 times; 14 times after enterostomy and once after enterostomy and entero-enterostomy. In the 34 cases complete obstruction existed 18 times. Twenty cases survived the operation, in 9 of whom complete obstruction was present. In six cases the length of life after operation is not given. Fourteen lived from seven months to two years or more. Six remained well for more than three years; that is a possible permanent cure was obtained in only 8.4 per cent. of all the cases in which operative relief was attempted.

These six were in detail as follows:

Bitlon-Pollard: Colloid carcinoma, size of fist. No lymph-nodes present. Male, age twenty-nine, flatulence for four years, colicky pain with constipation for one and a half years and melena. Resection April 8, 1901, including tumor and only two inches healthy bowel on either side. End-to-end anastomosis. In "perfect health" when reported, December 3, 1904 (three and a half years).

Hochenegg: Male, age forty-one, small annular cancer, freely mobilized and brought outside wound, surrounded with iodoform tampon. Proximal enterostomy. Resection and suture. (End to end or lateral not stated.) In perfect health five years later.

Bitlon-Pollard: Female, age fifty-five years, a mass, including the cancer of the flexure, and involving the left kidney, and the tail of the pancreas was mobilized and brought out through an oblique incision. Excision of 14 inches of colon, and end-to-end anastomosis with the Murphy button. Obstruction occurred and was relieved by colotomy and removal of the button five days later. Slow convalescence. Good health five years and three months later.

Böckel: Female, age forty-three, annular cancer with lymphatic involvement. Twenty centimetres colon resected with end-to-end anastomosis. Fecal fistula for short time. Good health five years later.

Sasse: Female, age thirty-six, extensively adherent carcinoma. Resection from middle of transverse colon to beginning of sigmoid. Direct suturing end to end. Spontaneous closure of fecal fistula. In good health after seven and a half years.

Kosinski: Female, good health eight years after resection.

The following abstracts of cases since Madelung's report present points of interest bearing on the diagnosis and the outcome of operative interference:

Denk: I. (Case 20), 1906. Male, age seventy-one, cancer of splenic flexure and gastrocolic fistula. Two-stage operation. Death from peritonitis and pneumonia. This patient had had stomach crises for ten years. For one year past emaciation, anorexia, constipation. For five months putrid belching, increasing prostration. For two months fecal vomiting and diarrhœa. Abdomen soft, tenderness over left costal arch. No tumor felt. Operation. Tumor at splenic angle adherent to and perforating the stomach and adherent to the diaphragm. Mass shelled out and defect covered with peritoneum. Resection of part of gastric wall. Colon brought forward. Mikulicz tamponade. Next day tumor removed. Adenocarcinoma. Patient lived three days.

II. (Case 26), 1908. Male, age thirty years, cancer of splenic flexure with ileus. Splashing and rumbling for eight months. Belching, vomiting, obstinate constipation. Occasional blood in stool. For four months rigidity of bowels. High degree of meteorism. Distinct peristalsis. No tumor felt. Operation. Growth size child's fist at splenic flexure. Opening (colostomy) at hepatic flexure. Tumor brought forward and two days later extirpated. By reason of gangrene no histological examination could be made. One month later von Frisch apparatus was placed in the colostomy opening and functionated well. Bowels also moved naturally. Two months later the enterotribe was used and in another six weeks the fecal fistula was closed with semicircular suture.

III. (Case 36), 1907. Male, age forty-seven years, chronic ileus. For two months past had violent crises of colic and vomiting. Obstinate constipation. Marked emaciation. Abdomen inflated. No tumor felt. Intestines rigid. Operation. Splenic flexure almost closed by cancer. Brought forward with rubber drain in proximal segment. In three days tumor removed. Three weeks later enterotribe used. In two months fistula closed with semicircular suture.

Clogg: Brief mention of 10 cases of cancer of the splenic flexure. Two were presumably operable and were operated on radically. In one case operation was successful; in the other death was due to postoperative adhesions. Of 8 inoperable cases, in 1 there were secondary tumors in the liver; 1 was secondary to a growth in the ovary; 4 were hopelessly adherent; 1 ended in perforated peritonitis and 1 was associated with localized abscess. Elsewhere he states that his two operations for cancer of the splenic flexure were followed by death in four months and nine months respectively.

Barker: Male, age sixty-two, admitted to the hospital for complete intestinal obstruction. Immediate artificial anus established in the lower part of the ileum. Second operation six weeks later; postponed on account of ulceration at the ileostomy wound; ileosigmoidostomy proximal to ileostomy. Third operation one week later—extirpation of cancer of splenic flexure—both ends of divided colon were closed. Fourth operation twelve weeks later, excision of artificial anus, and closure of the proximal portion of the ileum. Distal end sutured to skin as safety-valve for the closed cæcum and colon. Five years later the patient had gained several stone in weight. The "safety-valve" had, until recently, discharged freely fluid with fecal taint, but is now drying up. A little mucus and gas continue to escape.

Hutchinson and Wolbach: Female, age sixty years, had complained of abdominal pain for about six months. Generalized but worse in upper half. Constipated for about the same length of time. The pain, slight and colicky, was almost continuous. Thin, anæmic, with fairly prominent abdomen, tense and tympanic, no mass felt, no intestinal movements of ileus.

On admission to the hospital the bowels had not moved for a week. Prompt relief from enema. In a few days return of colicky pain. Exploratory incision. Remains of extensive peritonitis as shown by many adhesions. No sign of colonic

obstruction (a band compressed the small intestine somewhat). Suspicion of growth within the colon. Adhesions prevented an anastomosis. The small intestine was freed as a first stage. Against orders she ate solids and died of acute recurrence before she could be operated upon. Autopsy revealed a cancerous ulcer exactly at the splenic flexure with a secondary abscess lying between the colon, kidney and spleen.

Brewer: Male, age forty-seven, received in the Roosevelt Hospital for acute intestinal obstruction. History of numerous crises of abdominal pain for the past nine or ten months, which had always yielded to catharsis and dieting. Two days before admission a crisis of pain, not relieved by catharsis. Vomiting had set in with increased pain. Abdomen tender and moderately distended. Enemata failed. No stool or gas for twenty-four hours. Abdomen opened through median incision without diagnosis. Small intestine and colon up to splenic flexure much distended, sigmoid collapsed. Palpation revealed tumor at splenic flexure. Cæcostomy done. Two weeks later second operation. Colostomy sealed up and long incision made over descending colon. Three inches of bowel involved just below flexure. Transverse colon clamped and divided two inches above mass. Descending colon mobilized, isolated, clamped and divided just above junction with sigmoid. Intervening gut removed, with large share of mesocolon. Both open ends closed and turned in. Lateral anastomosis between transverse colon and sigmoid. Good operative recovery. On the fifth day natural movement. Colostomy wound gradually closed. Discharged in good condition. Diagnosis: Adenocarcinoma. In discussion Woolsey mentioned two cases of cancer of the splenic flexure in which there were no premonitory symptoms up to the time of obstruction. In one patient obstruction was absolute. Resection was performed. The second patient had been in a state of obstruction for four days before visiting the hospital. An artificial anus was established.

Westbrook: The cancer was situated a few inches below the left angle. Female, age forty-seven, abdominal pain for months. Six months before consultation had submitted to abdominal hysterectomy. Pain continued, thought to be due to adhesions from operation. An acute obstruction developed. Median incision, many adhesions but no constricting bands. Annular carcinoma found as above stated. Five inches of bowel resected, ends brought out and sutured as double barrel. Paul's tubes inserted. Lateral anastomosis and closure of fecal fistula later. No recurrence in four years.

Syms: Adenocarcinoma of splenic flexure of colon in a woman of seventy years. Annular, causing almost complete obstruction. Emergency operation. Cancer appeared rather as a constriction than as a tumor. On account of the patient's precarious condition, only a short-circuiting operation was done, the transverse to descending colon. The palliative operation apparently stopped the growth of the cancer. Was in perfect health four years later. She then died suddenly from perforation of bowel above anastomosis, after two days of pain and constipation. It was found that the disease had made no appreciable progress. Diagnosis was confirmed by microscope after autopsy.

Delbet: Female, age thirty years, complete occlusion for five days. Cæcum and ascending colon distended, sigmoid empty. Delbet was unable to find the obstruction and extended the incision to the two flexures when it was located at left flexure. Incision over splenic flexure immediately below the ribs, the median incision being closed.

Operation in two stages. Tumor exteriorized (it was but slightly movable). A U-thread was made to pass twice each through the lips of the incision and the mesentery. Patient rallied notably after establishment of the artificial anus. Ten days later the tumor was ablated. Two months later the colon was mobilized and the two ends united with a double circular suture.

Morison: Male, age sixty-two years, was admitted to the hospital for acute

obstruction, following a long period of chronic obstruction. Cæcostomy February 16, 1909. On March 13th removed a growth at splenic flexure with half of transverse and descending colon, with anastomosis between transverse and iliac colon. March 27th, cæcostomy closed. No local recurrence in four years. (Later had cancer of cheek and neck lymphatics, also successfully operated upon.) Colon cancer of the usual columnar cell type.

Rotter's cases: I (Case X). Male, age fifty-seven years. Six weeks before consultation had colicky pains, worse on left side. Meteorism and severe intestinal hemorrhage. After a brief remission the symptoms returned. Moderate degree of meteorism. A large firm tumor felt below the left costal arch, extending upwards beneath the ribs. There appears to have been no preoperative diagnosis other than ileus. Laparotomy. Cancer of the left colonic angle, adherent to posterior abdominal wall, mesentery of small intestine, and stomach. Growth also penetrated into the kidney to which it adhered. Attempts to loosen adhesions were abandoned. Artificial anus in transverse colon. Marginal necrosis of the edges of the conducting segment of bowel. Operative recovery. Discharged improved.

II (Case XIV). Male, age fifty-nine years. For several months before consultation, tendency to constipation. For three days complete obstruction. Marked meteorism. Operation. Left-sided pararectal incision. Very large tumor at left angle of colon. While endeavoring to mobilize this, a fœtid fecal abscess was ruptured. Artificial anus in left side of transverse colon. Death ten days later. Autopsy. Diffuse peritonitis. Metastases in the liver. Thrombosis of left iliac vein.

III (Case XVIII). Male, age fifty-four years. Intestinal disturbances for two years, colicky pains at intervals for six months. Intervals progressively shorter, crises more severe. Abdomen moderately distended and tender to pressure. After purgation abdomen softer. Induced splashing sounds in small intestine. First operation. Cæcal fistula. Palpation showed tumor in left angle of colon. Second operation, one month later. Mobilization and resection of portion of the pancreas, spleen and stomach. Difficult detachment from kidney. Radical operation abandoned. Death from collapse in thirty-six hours.

IV (Case XXII). Male, age thirty-nine years. For months temporary attacks of colic across the abdomen. Relief from purgation. In past few weeks attacks frequent and severe. Two days before consultation fecal vomiting, notable meteorism, no stool, no flatus. When first seen was in collapse. Abdomen very tender to palpation. Operation. Right-sided, pararectal incision. Carcinoma 8 cm. long in left angle of colon. Transverse incision to left. Tumor mobilized, extirpated. Artificial anus. Death from collapse in ten hours.

V (Case XXIII). Female, age fifty-eight years. For some months abdominal pains, not colicky. Irregular stools. On examination no meteorism. Smooth, movable tumor to left of navel, suggesting a floating kidney. Operation. Left transverse incision. Cancer at left angle of colon adherent to root of mesentery of small intestine, hence inoperable. Ileosigmoid anastomosis. Death in five days from asthenia. No peritonitis.

VI (Case XXXIII). Female, age thirty-eight years. Uncomfortable for fourteen days. Meteorism. Stool only after strong laxatives. On inspection marked meteorism. Diagnosis of chronic ileus and cancer of left angle of colon. First operation, fistula cæci. A tumor size of a walnut could be felt in the flexure. Second operation (interval not stated), lumbal transverse incision. Tumor exactly in the angle. Transverse colon thick as an arm, inflated, filled with hard stools, prolapsed. Detachment from spleen and stomach. The tumor and transverse colon resected together. End-to-end anastomosis of right transverse to descending colon. Three planes of circular sutures. Sutures covered with omentum. Extraperitoneal cigarette drain. Complete operative recovery.

VII (Case XLV). Male, chronic ileus. First operation, left-sided oblique incision. Transverse colon greatly distended, prolapsed. Tumor in left angle. Bowel loosened. A "double" anus established. Second operation. In crushing the septum, the result was incomplete. A spur remained, and when this was split infection resulted with death from peritonitis in four days.

VIII (Case XLIX). Male, age forty-three years. Notes of case lost. Cancer of left angle. Ileosigmoidostomy. Resection from middle of transverse colon to descending colon. Both free ends closed and ileum divided. The lower segment was sutured into wound while the upper one was united end-to-side with the sigmoid. Recovery.

All these patients were in bad physical condition.

Renon: Case I. Female, age sixty years. Received in hospital for intestinal occlusion of twelve days' standing. She was in very bad condition. The occlusion had been preceded by several months of constipation. Cæcal fistula established. Second stage seven weeks later. Median laparotomy. Recognition of cancer at the splenic angle. It was extirpated and an ileosigmoid lateral anastomosis made with splenic anus. One year later the lower extremity of the splenic anus was doing most of the excretion. An attempt was made to exclude the cæcum, but the patient died from the operation.

Case II. Male, age sixty years. Gastric disturbance for years, with vomiting at times and a yellowish skin. For six months he had been constipated, but had had no true crises of occlusion. The exploratory laparotomy revealed a small cancer at the splenic flexure. The affected loop of intestine was exteriorized, and eight days later resection was performed with semicircumferential anastomosis. The patient made a good recovery, and six months later the splenic anus was closed. Death followed, due apparently to duodenal hemorrhage.

Case III. Male, age sixty-six years. Intestinal occlusion. Laparotomy and division of two bridles which compressed the small intestine. Cancer of splenic flexure discovered. Cæcal anus. Two weeks later colon exteriorized and growth ablated. Half circumferential suture, with resulting necrosis of a portion of the intestine. Was living and well three years later, and would not consent that the splenic anus be closed.

Case IV. Male, age fifty-nine years, sudden intestinal occlusion. Cæcal anus. Nearly six weeks later exploratory laparotomy. Recognition of cancer of the splenic angle. Immediate extirpation. Death from peritonitis.

Truesdale (two cases): I. Female, age sixty-three. Acute obstruction present. Laparotomy with mobilization of the tumor and adjoining colon. Transverse colostomy. Twenty days later resection with lateral anastomosis, the closed ends being placed extraperitoneally in the abdominal wound as advocated by Bloodgood. Recovery. Seen thirteen months later with evident uterine cancer.

II. Male, age sixty. There was no obstruction, but rapid loss of weight, and a growth palpable through the soft, flat abdomen. To distinguish between a growth on the greater curvature of the stomach and one at the sigmoid flexure, X-ray pictures were taken. The greater curvature was seen to be smooth, pylorus normal. The transverse colon showed interference with peristalsis. The bismuth appeared to collect in an irregular mass toward the splenic flexure, beyond which was a short segment in which the bismuth showed canalization. On this evidence a diagnosis was made of cancer of the splenic flexure. After several days of preparation, a laparotomy was done. Resection of the tumor and a safe margin of the healthy colon. Anastomosis impracticable because of tension. Lateral ileosigmoidostomy done with double exclusion. Cæcostomy to drain the remaining closed colon. Recovery. In good health thirteen months later.

Abbott: Two cases. I. An adenocarcinoma of the splenic flexure in a woman of forty. Eleven months before admission began to be troubled by constipation. This increased until four months later she exhibited absolute obstruction with

vomiting. Spontaneous recovery. Two months later a second attack of stoppage when a cæcal fistula was instituted. Recovered again with persistence of a slight sinus which occasionally leaked. Constipation again returned, and there was, on one occasion, a four-day attack of vomiting. Was now losing flesh. When first seen, abdomen was distended, and nothing could be palpated. Laparotomy. Growth at splenic flexure of colon. Right lumbar colotomy. Second stage deferred because of suppuration in anterior wound. After some weeks an extensive resection was performed, followed by lateral anastomosis. Good operative recovery.

II. Male, age sixty-five years. When first seen he was in the hospital with abdominal distention, obstipation and vomiting. He had had a similar attack one year before. Relieved by use of laxatives. He had a second attack four months later, and was in the hospital five weeks. Since then he had had almost daily trouble. The distention suggested obstruction at the splenic flexure. An exploratory incision to the left of the median line failed because of distention. Wound closed and right lumbar colotomy performed. Eighteen days later second stage. Inflammatory adhesions held the mass up. The same operation as in preceding case. Drainage through a stab wound in the loin in both cases.

Souligoux: Male, age sixty years. Seized with vomiting. As he had suffered a long time with stomach trouble, a diagnosis was made of stenosis of the pylorus. Concurred in by a number of colleagues. Laparotomy. Cæcum, ascending and transverse colon very voluminous, distended with gas. Stomach was entirely normal. At left angle of the colon a neoplasm, fixed and hard. This was exteriorized with difficulty and a cæcal anus established. Patient died in the night.

Aaron: Male, age fifty-five years. Sick for past year with "stomach trouble" and had lost thirty-five pounds. Constipated and cachectic. About five months before exploratory laparotomy had disclosed a presumably inoperable cancer of the splenic flexure. For six months he was treated with vaccines. Was then operated on (extensive resection and anastomosis between hepatic flexure and sigmoid) and he died eight days later from hypostatic pneumonia. The growth was an adenocancer of the flexure in an advanced stage.

Wette: Briefly mentions one case which exploration showed to be large and inoperable.

Savariand: Case reported by Bary. Female, age not given. Ileus of two days' duration, violent pain and complete occlusion. There was a history of two similar crises, two months and one month before, less prolonged and less severe. There was a tender point in the epigastrium a little to the left of the midline. There is no allusion to any preliminary diagnosis. Median laparotomy disclosed a dilated transverse colon, a loop of which was exteriorized. Twelve days later the cancer was excluded by an ileosigmoidostomy. The anastomosis functionated at first, but a fecal abscess formed and the fæces escaped through the fistula. In eighteen days the cancer at the flexure was extirpated by resection, and end-to-end anastomosis, and the abdomen closed. Healing was marred by abscess formation, but ultimately there was complete recovery, the fistula healing spontaneously.

Mumford: Cites an inoperable cancer of the splenic flexure the first indication of which was an acute obstruction.

Veaudeau: Prolonged history of partial obstruction with severe attacks. No blood in stool. Cæcostomy done in presence of acute obstruction. Position of tumor afterward determined by bismuth X-ray examination. Six weeks later the tumor, with adjoining bowel, was mobilized and brought out of the abdomen, without sectioning the mesocolon, the afferent and efferent arm being placed in apposition. The parietal peritoneum was closed around the colic peritoneum. One week later the tumor was removed with the cautery, the afferent and efferent loops sutured in contact. About three weeks later the enterotribe was successfully used and after two weeks the open ends of the colon were closed under local

anæsthesia. Finally the cæcostomy was closed. Patient in excellent health with normal bowel function at the end of two years. The cancer was scirrhus in type, annular in growth, and there remained a lumen of 8 mm.

He reports two cases. I. Passot. Male, age fifty-six years. Cancer at splenic flexure with obstruction and peritonitis due to perforation of cæcum. Laparotomy with establishment of cæcal fistula at the perforation and peritoneal drainage failed to save the patient. Autopsy revealed a large cancer at the flexure which was adherent to the pancreas, kidney, and stomach.

II. Patel et Murad: Male, age fifty-one years. Entered with symptoms of obstruction. Operation revealed a peritonitis, but no mechanical obstruction. Cause of peritonitis not determined. Death. Autopsy revealed a cancer at the splenic flexure. Small, annular, stenosing. Colon dilated. No perforation. "Peritonite par propagation."

Peck: Male, age forty-seven years. September 12, 1909. Obstinate constipation for three months. Partial obstipation for two weeks. No blood in stools. Mass felt on deep palpation just below the left costal arch. Operation September 13, 1909. Cancer of the splenic flexure. Somewhat fixed to posterior parietes. Numerous enlarged glands in mesocolon were found. Distention of transverse colon. Growth, with adjoining transverse, all of the descending and part of the sigmoid, together with accompanying lymph-glands, was mobilized and excised. Nineteen inches of bowel removed. Cut ends inverted, side-to-side anastomosis between transverse colon and sigmoid. Cigarette drain. Most of abdominal wound closed. Patient in marked operative shock from which prompt recovery was made. Normal defecation on third day. Slight fecal leakage on sixth day, with spontaneous closure on fifteenth day. Patient was exhibited fourteen months in excellent condition. Weight was ten pounds above normal. Growth described as advanced carcinoma, with a good deal of associated inflammation. Histology of lymph-nodes not given.

Moynihan: Female, age sixty-two years. Diagnosis of malignant stricture of the splenic flexure, crises of subacute obstruction of bowel. After enemata the abdomen became hollow, and the growth could be felt plainly. Laparotomy showed a distended transverse colon, and a collapsed descending colon and sigmoid. Tumor is so adherent in all directions as to be inoperable. An ileosigmoidostomy was then performed. The patient at once improved and after an interval—not stated—the tumor was no longer palpable. Moynihan states that it is "almost" certain that it could not have been cancerous, but "some form of chronic inflammation." The question is thus left open.

Paul states that he is convinced that such cases may be cancer (Cf. Syms case).

Huguier: Female, age fifty-nine years. Gave a history of crises of diarrhœa and pain. Former went back for three years, while the latter were very recent. A large tumor was readily made out by palpation. Nutrition was excellent. A renal tumor having been excluded by ureteral catheterization, a laparotomy was performed. The belly of the tumor was constituted by the splenic flexure. It was a fatty looking mass which adhered to the abdominal wall, and after mobilization the colon was resected and an end-to-end suture applied. The growth was as large as two adult fists, and was surrounded by a layer of adipose tissue "pericolite graisseuse." The mucosa of the colon was the seat of an annular mass of cauliflower appearance with ulceration. The tumor is called a cylindrical epithelioma.

Castaigne: Female, age forty-two. For two years she had had some affection which could not be diagnosticated. There was pain about the stomach and spleen, severe, occurring in irregular crises. Were found to occur very often, two or three hours after a meal. She also had these pains at times when at stool, and then they appeared to come from the stomach, which felt heavy. There was

some radiation to the left shoulder, and at times she vomited. The syndrome was like biliary colic, only on the wrong side. She had had more or less stomach disorder since childhood. Her physicians, therefore, regarded her as a nervous gastropath. She consulted an expert neurologist, who confirmed this diagnosis. She was placed under a gastrologist's care, who found marked hyperchlorhydria. Examination of fecal matter showed absence of blood and other abnormal constituents. For three months she improved on regimen. The painful crises then returned. She was radiographed, and a diagnosis made of cancer of the splenic flexure of the colon. The stomach was now found free from all acid whatever. Refusing to entertain the diagnosis of malignancy, the patient began to travel for her health, visiting cures and sanatoria. The diagnosis was an isolated gastropathy. She improved somewhat, and was told that the radiograph taken had no diagnostic value. She returned to Paris seven or eight pounds lighter; went to Jura and regained her weight. The author was now consulted and ignored all former diagnoses (he was not told of the X-ray). He found that she was using some morphine, and her physiognomy suggested carcinoma. Palpation revealed an abdominal tumor of uncertain localization. A splenic tumor could be eliminated. An X-ray was advised. Two different men examined her, and both agreed on the diagnosis, "neoplasm of the splenic flexure." Just as she was about to be operated on she developed an intestinal hemorrhage and signs of peritonitis, and died four days later.

Among the foregoing there are records of 43 cases since Madelung's paper in which the result of operation is stated. There were 21 primary recoveries, and 22 operative deaths; a mortality of 51.1 per cent. In 14 instances the operation was palliative, while in 29 cases a radical removal of the growth was done. Of the latter, 17 survived the operation, while 12 died following it; an operative mortality of 41.3 per cent. The radical operation of resection was done 19 times, either as a second stage operation after enterostomy, or with a coincident enterostomy at the time of the resection, and 10 times without provision for colonic drainage. Fourteen of the first group survived and 5 died; an operative mortality of 26.3 per cent. In contrast to this, only 3 of the patients in the second group survived and 7 died; an operative mortality of 70 per cent., nearly three times as great as in the first group. This marked difference must be due in some degree to the fact that colonic drainage is a measure of safety and not entirely to coincident factors.

The records contain many reports of only one or two cases, and as a rule these are only published when successful. Again we find reports in more than 30 cases in which there is every reason to believe that recovery did not take place, though the text is silent on this point, the presentation being from the pathological standpoint, or for the purpose of illustrating some point in symptomatology.

Making due allowance for all these sources of error, we are inclined to believe the operative mortality in cancer of the splenic flexure is 60 per cent. or more, if all cases are included in which any attempt to operate is made. The records are woefully inadequate for determining the proportion of the 40 per cent. that continue in good health for a year or more. Madelung found only 6 cases in 83 that could be considered as cured. (Three to

eight years.) Rotter seems to have only 1 in 10. Veaudeau a possible 1 in 3. Only 1 of our 5 operated cases lived more than three months, and he died in something over two years from peritoneal carcinosis.

It would be a matter of interest to determine the mortality and the probability of cure in cases that were operated prior to the appearance of acute symptoms, but we have been unable to satisfactorily do this. There are scattered records of at least 28 cases, in which operation was successfully undertaken in the presence of either obstruction or abscess formation, and curiously enough some of the most satisfactory and permanent results were obtained in spite of apparently hopeless conditions, *e.g.*, Bilton-Pollard, Sasse, Brewer, Truesdale, and temporary smears in Cases I and III of our series.

It is thus evident that cancer of the splenic flexure, the failures notwithstanding, is a lesion with which surgery may successfully deal. Our problem, therefore, is to utilize the means at our disposal and make them more effective. The all-important question of early diagnosis has been fully discussed. How urgently this study is needed is emphasized by the fact that in more than two-thirds of the cases just cited, all the evidence for a diagnosis was present many months before the patient came to operation with an acute life-endangering complication.

There remains for consideration the actual surgical procedure to be followed, first in the uncomplicated cases, and second in the complicated cases. Two principles obtain in the practice of various operators, and our study of the literature leads to the conclusion that successful results reward one much more than the other.

These principles may be designated as the one and the two or more stage attack. In the first an attempt is made to eradicate the disease and completely restore the patency of the colonic lumen at one sitting. This is accomplished either by a closure of the severed ends of the colon and a lateral anastomosis or by end-to-end anastomosis.

The many stage operation is variously accomplished. A preliminary cæcostomy or colostomy is done. At a subsequent date the tumor and adjoining bowel is mobilized and brought outside of the peritoneal cavity with the afferent and efferent loops in contact, and excluded with tampons or peritoneal suture. At a third sitting the requisite amount of bowel is excised, the afferent and efferent stomata remaining open. As a next step the enterotribe is used to reëstablish the colonic lumen and finally, if need be, the cæcostomy and the colonic openings are closed. This, in general, is the Mikulicz operation. Paul modifies it by removing the segment of colon and placing large glass tubes securely in the open ends of the colon at the second sitting. It is further shortened by various reporting surgeons by dispensing with the primary artificial anus. Others do the lateral anastomosis also at the sitting, so as to eliminate the later use of the enterotribe.

Most writers agree that the many stage operation or its modification, is safer than the other, and strongly advocate it in spite of its long incapacitating and unpleasant course. (*e.g.* Mikulicz, Madelung, Rotter, Paul, Veau-

deau.) Our collected cases show a mortality approximately 3 times greater in the one stage than in the many stage procedure. Careful study indicates that the failures in the one stage operation would have been avoided by the other mode of attack. These failures arose almost entirely from leakage somewhere along a suture line, with a resultant peritonitis or improperly drained abscess. (Case II in our series.)

In the final analysis it must be accepted that greater safety is maintained by the abandonment of the one stage operation. There is a definite field for it in cancer of the more mobile parts of the colon, but not in the fixed inaccessible splenic flexure.

Naturally, its abandonment is imperative in the complicated cases. In the presence of obstruction or abscess formation, it is foolhardy to attempt a radical operation. It is absolutely needful that a preliminary drainage of the colon be established, and a sufficient time be allowed for recovery of the inflamed proximal bowel before any resection is attempted.

One additional point of importance remains to be discussed, *i.e.* the extent of bowel to be removed with the contained tumor. As pointed out, the flexure itself, with its immediately adjoining colon, particularly on the distal side, presents a considerable surface devoid of peritoneum. The absence of a circumscribing longitudinal muscular coat in the colon leaves a very thin wall where both peritoneum and muscle are lacking. Suturing such portions is a matter of difficulty and uncertainty. Moreover the mobilization of the distal transverse colon and the proximal descending colon is sometimes not sufficient to bring the two into close alignment. (See Case III.) Tension results, and renders the suture line still more precarious. All these difficulties are surmounted if one frankly sacrifices the distal half of the transverse, and the entire descending colon. The remaining transverse colon and the sigmoid are readily mobilized to a sufficient degree to lie in close parallel contact, and both are covered with peritoneum, practically throughout. These facts make their immediate lateral anastomosis easy, or give ideal conditions for the subsequent use of the enterotribe.

The following conclusions sum up the results of the study of our own cases and of the additional ones we have been able to find in the literature:

1. The splenic flexure is the third most common site for the growth of colonic cancer.

2. This growth tends to the production of obstruction with indeterminate premonitory symptoms.

3. This complication occurs acutely in nearly three-fourths of the cases coming to operation.

4. A recognition of the foregoing facts, and a more careful detailed study, with a possible exploratory operation, should lead to an early diagnosis in a majority of the cases, and thus forestall acute complications.

5. The probable operative mortality of all cases up to the present time is over 60 per cent., and the per cent of the prolonged cures is exceedingly low, 10 per cent. to 25 per cent.

6. These appalling results are largely due to the delayed diagnosis, and an improper mode of attack.

7. The latter should follow the principle of the two or more stage operation with provision for external colonic drainage, either as a preliminary, or at the time of resection; always the former in the presence of serious obstruction or abscess formation.

8. The distal portion of the transverse colon, the flexure and the entire descending colon must be resected in order to obtain the requisite conditions for a secure anastomosis with an ultimate patency of the colonic lumen.

9. Notwithstanding the meagre success thus far obtained, attention to the lessons learned from the successes and failures of those who have worked in this field justifies the hope that this lesion may be as satisfactorily dealt with as cancer in other parts of the body.

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INFECTIONS IN PROSTATE CASES*

By Edward Starr Judd, M.D.
of Rochester, Minnesota

The importance of the pre-operative treatment and the postoperative care of patients following prostatic operations is well established. A great deal has been done also to improve and simplify the operative technic, so that at the present time the operation is a much more definite surgical procedure than formerly. The element of infection in these cases has received due consideration, although apparently a great deal remains to be learned. In two seemingly parallel cases, one patient may have a very severe infection at any time following the operation. It is an accepted fact that the patient who has cystitis and other evidence of chronic infection at the time of operation is likely to be a better risk and is almost certain to have an easier convalescence than the patient who has a perfectly clean bladder and no symptoms of infection in the urinary tract. This would seem to suggest that the infection had produced a definite immunity, and further that some benefit might be expected from the preliminary use of vaccines.

In the majority of instances a very definite and characteristic reaction is brought about by pre-operative treatment. Just what the etiologic factor of this reaction is has not been decided. It is characterized by general weakness, irritability, inability to rest, and loss of body weight. During the height of the reaction the specific gravity of the urine and other tests show that the function of the kidney is very much diminished. There is a marked reduction in the blood-pressure, which is usually high. After the reaction subsides all these symptoms disappear. The renal function apparently returns to normal, although the specific gravity of the urine will probably never reach the point of its first reading. During the reaction there may be much evidence of infection such as chills, increased temperature, and pus in the urine, and in some instances blood cultures will be positive. This infection, if it is an infection, is characteristic. A patient well along in years will withstand a long abdominal operation under a general anæsthetic even though there is considerable infection in the operative field, and yet if at any time during convalescence this same patient has retention of urine so that catheterization is necessary for some time, there is almost sure to be more reaction from this procedure than from the abdominal operation. I do not believe we can accept the theory that the reaction which generally follows catheterization and the withdrawal of the residual urine is always due to infection alone. The reaction may occur at any time without any evidence of infection, and it would seem that it might be due

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to the change of pressure within the pelvis of the kidney, which permits a sudden congestion. This in turn interferes with the renal function.

In the somewhat detailed study of a small series of cases herewith presented an attempt has been made to ascertain as nearly as possible the part infection plays in the reactions which take place during the preparation of patients either by draining the bladder through a urethral catheter or through a suprapubic opening. It has been of interest also to find out just how often infection occurs during convalescence, and how much of a factor it is in the convalescence and in determining the mortality.

Infection in the kidney is the most important factor to be taken into consideration. The question arises as to whether many of these patients do not have a more or less chronic infection of the kidney from the beginning of the urinary symptoms. An infected kidney does not continuously pass organisms into the urine. An area of infection may be walled off so that the urine is free from pus and organisms except at intervals when the area opens up and discharges into the calyx or pelvis. This is known to have occurred in several instances; the urinalysis did not indicate any infection in the kidney, although at operation or autopsy considerable evidence of infection was shown. I believe that this is a frequent condition in prostate cases. As soon as any treatment is begun, the infection increases because of the changes brought about in the kidney, and bacteria and pus appear in the urine. The change in the urinary apparatus is made by the withdrawal of the residual urine. When the urine is free from bacteria before treatment is begun, but shows pus and organisms a short time afterward, it is usually believed that the infection is due to contamination during treatment. This is undoubtedly true in some cases, but it would seem that the appearance of pus and organisms in the urine does not necessarily mean the treatment has caused an infection. Just why the kidneys become infected, and the route by which the infection enters them, has been the subject of considerable discussion. Crabtree and Cabot[1] believe that the blood stream is by far the most frequent source of infection. They cite the case of a man under preparation for prostatectomy whose urine at the time of admittance to the hospital was found by culture to be free from infection. The catheter had been in place for several days during which time there were no symptoms and the cultures were sterile. On the eighth day the patient complained of burning in the urethra; two hours later he had a chill and a sharp rise in temperature. Blood cultures made two and a half hours after the onset of symptoms showed a pure growth of colon bacilli. No bacteria were found in the cultures from urine made at the same time, but cultures of the urine several hours later showed abundant colon bacilli. The functional test dropped twenty

[1] Crabtree, E. G., and Cabot, H.: Colon Bacillus Pyelonephritis. Jour. Am. Med. Assn., 1917, lxviii, 589–591.

points in twenty-four hours. The patient presented all the evidence of pyelonephritis, but with constant urethral drainage for another week renal function returned to within five points of the former reading. At this time a prostatectomy was performed. A secondary hemorrhage occurred on the ninth day and the patient died. The autopsy showed that the kidneys were pale and had normal markings. There was no dilatation of the pelves. Crabtree and Cabot believe this case to have been one of pyelitis and pyelonephritis. The diagnosis of pyelonephritis was based on the sudden drop in the kidney function, which they think was due to cloudy swelling probably involving the tubular portion of the kidney. They believe that in such cases the perivesical tissue becomes infected, but instead of lymphatic extension to the kidney, which is against all rules, the infection enters by way of the blood stream.

In some of these cases infection ascending by way of the urinary passages is probably the source of the kidney infection. Ordinarily, infection does not occur in this manner, but when there is an inflammatory thickening in the wall of the bladder and also in the lower end of the ureter (especially if there is obstruction in the urethra, producing back pressure into the ureter), infection may readily extend to the kidney through the lumen of the ureter.

Infection might ascend by way of the lymphatics if all the lymphatics were blocked, but under ordinary conditions, with the lymph draining normally, infection at the lower end of the ureter would be passed to the lymphatic glands in front of the sacrum. It is more likely that the perivesical infection finally reaches the kidney by extending into the lymphatics and then entering the blood stream.

The effect of the infection on the function of the kidney depends on the part of the kidney involved. There may be chills, fever, and considerable pus in the urine, and yet the renal function may not be greatly reduced. On the other hand, with little evidence of infection —no rise in temperature, no organisms in the urine—the renal function may be very greatly reduced. If the infection attacks the cortical part of the kidney, as is usually the case when it is of coccus origin, there will be considerable evidence of it, but the renal function may appear normal. If the infection enters the region of the tubules, even though it causes only a swelling in this region, the phthalein output is usually greatly diminished. This type of infection is usually produced by the colon bacillus. If the infection is mixed and due to colon bacilli and cocci as well, there will be much pus in the urine, marked evidence of infection, and also greatly reduced function.

Infection in the ureter is generally secondary to an infection in the wall of the bladder. The ureter is dilated, the coats are greatly thickened, and there are no peristaltic contractions. The dilatation of the ureter must be due to the increased pressure, and the hypertrophy to the

effort to force the urine past the obstruction. The trauma which precedes infection in the bladder and ureter is produced by the over-distention. Cystitis is often due to trauma produced by the catheter.

In the study of these cases bacteriologic examinations have been made of the urine and blood and also of the prostate and the wound after operation. In nearly all such examinations the blood cultures were negative, possibly because of the fact that they were not made immediately following the chill. According to Bumpus, cultures will often not be obtained from the blood a few hours after the chill.

The bacteriologic examination of the urine in five consecutive cases in which complete data were obtained showed that before treatment of any kind had been instituted Staphylococcus albus could be demonstrated in the culture in four of them. In one the showing was very scanty. In the fifth case no growth had developed in the media at the end of the fourth day. While all these cultures were taken with great care, it is not possible to be absolutely certain they were free from contamination. The presence of the cocci in the urine could not be explained. None of the patients had any rise in temperature or showed other evidence of infection.

A second bacteriologic examination of the urine was made of three of the five patients four days after the preliminary treatment was begun. The other two did not require pre-operative treatment. It is especially interesting to note that in all the cases, in addition to the staphylococci that were present at the first examination, there were colon bacilli in some or all of the media. In Cases III and IV, in which a primary prostatectomy had been performed, the urine gave a positive culture of colon bacilli in one case on the fourth day after the operation, and in the other on the fifth day, so that all five patients had colon bacillus infection four or five days after the beginning of treatment. The patient who had a primary prostatectomy showed some evidence of infection. On the fourth day he developed a temperature of 101.5°. In two instances cultures were taken of the hypertrophied prostate as soon as it was removed. The culture from the patient who had not had any preliminary treatment was negative. The culture from the patient who had been catheterized for several weeks showed a positive growth of colon bacilli.

The five patients all made good recoveries without complications. They were discharged with wounds completely healed within five weeks after the prostatectomy. Only one patient had a temperature as high as 102°, and this lasted but a few hours. Possibly the convalescence in these cases was better than is usual, yet at approximately the same time after the beginning of treatment, cultures of the urine in each case showed colon bacilli and staphylococci. This would seem to suggest either that these patients had a natural or acquired resistance to these bacteria, or that the bacteria were not especially active. There was no suggestion at any time of insufficient elimination from the kidney. Since

positive cultures were found in all these cases, does it not seem probable that they are common in this condition? Such cultures point out what will take place if for any reason the patient's resistance is greatly lowered or the activity of the organisms is increased.

Vaccines were not given in these five cases. Recently we have made a study of twenty-one prostatic cases to determine the effect of the use of Bacillus coli vaccines. Twelve of the cases were pre-operative and nine postoperative. Each patient received Bacillus coli vaccine every four days, beginning with fifty million and increasing to five hundred million, the maximum dose. A microscopic examination of the urine was made every week, and, with one exception, colon bacilli were found. However, none of the twenty-one patients has shown any evidence of severe infection, and it is possible the use of the vaccine may have modified the infection considerably in spite of the fact that the colon bacilli persisted in the urine. Two of the twenty-one patients had chills. A blood culture made from one at the beginning of the chill was sterile. Both had white blood counts during the chill showing only about 25,000 leucocytes. The phthalein output dropped 10 to 15 per cent. at the time of the chill.

CONCLUSIONS

1. In prostatic cases, a definite reaction occurs during the pre-operative treatment. In some cases this reaction may be due to infection in the kidney.

2. Several days after the beginning of treatment or after the operation has been performed, in a very large majority of cases, the urine shows a considerable number of colon bacilli. This cannot be due to contamination in every instance, although we are unable to say whether it comes from the kidney, the bladder, or the prostate itself.

3. The infection may be walled off in the kidney and therefore no organisms will show in the urine. Simultaneously with any form of treatment, the infection becomes active and the urine immediately shows bacteria.

4. Colon bacillus vaccine may modify the infection, though it does not decrease the number of colon bacilli in the urine.

CASE REPORTS

CASE I (A186131).—S. H., a farmer, fifty-seven years of age, married thirty years, twelve children. Urgency of urination, smarting and burning had existed for eight years and dribbling for three years. There had never been complete retention and a catheter had never been used. The patient had lost 15 pounds in weight. There was bilateral enlargement (encapsulated) of the prostate, 3 on a scale of 4. The bladder was distended. The right eye showed secondary optic atrophy; the left eye was negative. A twelve-hour specimen of the urine, 600 c.c., had a specific gravity of 1026, an acid reaction, and an

occasional pus cell, but was otherwise negative. Combined phthalein test: 260 c.c., 60 per cent. in three hours. There were 8 ounces of residual urine. The blood Wassermann test was negative. Blood urea (Van Slyke): 29 mgs. of urea per 100 c.c. The preparation of the patient consisted of catheterization twice a day for a few days and the use of a permanent catheter for several weeks. There was considerable general decline when the catheter was first used, but the subsequent improvement was marked. The blood-pressure before treatment was 125, 83. The phthalein return varied from 35 to 70 per cent. in two hours. On the eighth and eighteenth days during the preparation a chill, followed by a rise in temperature, occurred. A suprapubic prostatectomy was performed, the capsule being sutured and the bladder completely closed. A urethral catheter was inserted for drainage. The temperature did not run above 100, there were no complications, and the patient was dismissed with his wound entirely healed on the eighteenth day.

Examination of the blood before any preparation was made showed 70.7 per cent. polynuclears and 5400 leucocytes. At the time of the prostatectomy there were 74 per cent. polynuclears and 13,200 leucocytes. Several days after the prostatectomy there were 86.7 per cent. polynuclears and 25,600 leucocytes.

Bacteriologic examination of the urine before any treatment revealed Staphylococcus albus and a large saprophytic coccus on all media. The anaërobic culture was not good. Bacteriologic examination of the urine after four days of repeated catheterization showed Bacillus coli, staphylococcus, and yeast cells on a blood-agar culture. Bacillus coli and a staphylococcus were present on glucose agar. Bouillon gave a growth of Bacillus coli. Anaërobic cultures showed Bacillus coli and staphylococcus. Cultures of the urine some time after operation showed the pneumococcus on all media.

Bacteriologic examination of a glucose-agar culture of material taken from the gland at the time of prostatectomy showed the pneumococcus and Bacillus coli. Blood-agar, bouillon, and anaërobic culture gave growths of Bacillus coli and a gram-positive diplococcus, probably a pneumococcus.

Case II (A184364).—G. H. L., a farmer, sixty-one years of age. This patient was an old alcoholic and had had frequency of urination for five years. One week previous to our examination he had acute retention. The catheter was used once and since then there had been incontinence. Weight normal. Heart action slightly irregular. Hemorrhoids. Rectal examination revealed a large benign prostate. The blood-pressure after treatment was 150, 88. Urinalysis: 400 c.c., specific gravity 1018, albumin, red blood-cells and white blood-cells. Blood urea: 21 mgs. in 100 c.c. Phthalein test: 45 to 50 per cent. returned in 7 to 17 minutes. Because of the acute retention and much pain on passing the catheter, the preparation consisted in preliminary drainage of the bladder by suprapubic cystostomy. During the two weeks following this operation there was continuous improvement and at the end of that time a prostatectomy was performed. The tem-

perature rose to 102°+ soon after the operation, but was returned to normal in three days, and remained so until the patient was discharged with his wound healed at the end of four weeks.

The blood examination made when the patient was first seen and before any treatment had been given showed 70.7 per cent. polynuclears, 15,600 leucocytes. Six days after the drainage operation there were 67.7 per cent. polynuclears, 8200 leucocytes; six days after the prostate was removed, 77.3 per cent. polynuclears, 18,400 leucocytes.

Bacteriologic examination of the urine before treatment revealed Staphylococcus albus in bouillon, glucose-agar, and blood-agar cultures. Anaërobic glucose-agar culture was sterile for four days. Bacteriologic examination of the urine after suprapubic drainage revealed the staphylococcus, pneumococcus, and Bacillus coli in a bouillon culture. Blood agar showed the pneumococcus and Bacillus coli. Anaërobic agar showed the Bacillus coli and pneumococcus. Bacteriologic examination of the urine eight hours after prostatectomy showed the Bacillus coli and streptococcus in glucose-agar culture. Blood agar gave a growth of Bacillus coli and a diplococcus. Anaërobic culture showed the Bacillus coli. Blood agar and bouillon cultures of the urine six days after prostatectomy showed the Bacillus coli and a streptococcus. Glucose agar gave a growth of Bacillus coli and pneumococcus.

Bacteriologic examination of a culture taken from the wound four days after suprapubic drainage showed a staphylococcus in bouillon. The anaërobic culture was sterile. Glucose agar and blood agar showed the Staphylococcus albus and Bacillus coli. A culture made from the wound at the time of the prostatectomy showed Bacillus coli and staphylococcus. Six days after the prostatectomy, cultures from the wound showed the staphylococcus and Bacillus coli on glucose agar and in anaërobic media.

Case III (A4162).—M. D. S., a banker, fifty-six years of age; married twenty-eight years; two children. This patient had had urinary difficulty for six years, gradually growing worse. For three years he had had dribbling. He had never used a catheter. The physical examination was negative except that a hard and encapsulated enlargement of the prostate was palpated per rectum. The blood-pressure was 154,98. Urinalysis: 400 c.c. in twenty-four hours; specific gravity 1021; slight amount of albumin and pus. The blood examination showed 83 per cent. hæmoglobin, 9400 leucocytes. There was 1 ounce of residual urine. Phthalein test: 50 per cent. returned in two hours. Blood urea: 33 mgs. to 100 c.c. It did not seem necessary to institute any preliminary preparation. A prostatectomy was done without the drainage operation, as the amount of residual urine was small and the other examinations were satisfactory.

Examination of the blood on the day of the operation showed 66.7 per cent. polynuclears, 8800 leucocytes. Four days after operation there were 84 per cent. polynuclears and 11,600 leucocytes.

Bacteriologic examination of the urine before operation showed a scanty growth of staphylococci on all media. The blood-agar culture of the urine five days later (the patient's temperature had been 101.5°

the evening before, the highest at any time during the convalescence) showed Bacillus coli, staphylococcus, and pneumococcus. A bouillon culture gave a growth of pneumococcus and staphylococcus. Glucose agar showed Bacillus coli and staphylococcus. The anaërobic culture showed Bacillus coli and pneumococcus.

A culture made from the prostate soon after it was removed showed no growth.

The convalescence was uneventful and no evidence of infection was noted at any time. The wound was slow in healing, but this was evidently due to the condition in the prostatic urethra and not to the infection.

Case IV (A187926).—J. L. G., a janitor, sixty-five years of age; married thirty-four years; three children. The urinary difficulty had begun three years previously with urgency of urination and dribbling. The patient had never been catheterized. The physical examination was negative except that on palpation per rectum the prostate seemed to be benign, but enlarged, firm, and hard. The blood-pressure was 150–115, 150–90. Urinalysis: 600 c.c. in twelve hours; specific gravity 1030; otherwise negative. The phthalein returned in fifteen minutes, 60 per cent. in two hours. There were 2½ ounces of residual urine. Blood urea: 37 mgs. in 100 c.c. Examination of the blood showed 54 per cent. polynuclears, 4800 leucocytes. As the patient's general condition was good, the amount of residual urine small, and the specific gravity and renal function normal, it was not considered necessary to institute preliminary treatment, and suprapubic prostatectomy was performed.

Examination of the blood on the day of the operation showed 86 per cent. polynuclears, 10,600 leucocytes. Four days after the operation there were 80 per cent. polynuclears and 10,500 leucocytes.

Bacteriologic examination of the urine before any catheterization and before the operation showed staphylococci in all cultures. Anaërobic and aërobic cultures in bouillon and glucose agar were sterile. Blood agar showed no hæmolyzing streptococci. Four days after the operation a glucose-agar culture of the urine showed Bacillus coli and pneumococcus. Blood agar also gave a growth of Bacillus coli and pneumococcus. Anaërobic and aërobic cultures in bouillon showed Bacillus coli and pneumococcus.

Four days after the operation a culture from the wound showed Staphylococcus albus.

There was no rise in temperature or suggestion of infection at any time during the convalescence (the temperature was never more than a fraction above 99°), but on the sixth day a considerable number of colon bacilli and cocci were found in the urine. The wound healed in a little more than three weeks.

Case V (A150733).—J. M. P., a laborer on the road, sixty-five years of age; married forty-four years; four children. The urinary difficulty consisted in smarting on urination for the previous three years. Examination per rectum revealed a median enlargement of the prostate. The blood-pressure was 128–86, 135–95. Urinalysis:

750 c.c. in 12 hours; specific gravity 1028; otherwise negative. There were 2 to 3 ounces of residual urine. Phthalein test: A showing in ten minutes, 35 per cent. in two hours; second test, a showing in fifty minutes, 50 per cent. in two hours. Blood urea: 30 mgs. in 100 c.c. and 42 mgs. in 100 c.c. In spite of the good renal function, it seemed best to make a suprapubic drainage before removing the prostate, as the patient was not in a good general condition. No reaction followed the drainage of the bladder, and about three weeks later a suprapubic prostatectomy was performed. The temperature was 100° on the second and third days following the operation, but was not above normal at any other time during the convalescence, and the patient was discharged on the nineteenth day with his wound healed.

Examination of the blood at the time the operation for drainage was performed showed 85.3 per cent. polynuclears and 22,400 leucocytes. Five days later there were 80.3 per cent. polynuclears and 13,000 leucocytes. At the time of the prostatectomy there were 61.7 polynuclears and 18,000 leucocytes.

Bacteriologic examination of the urine at the time of the operation for drainage of the bladder showed pneumococcus on the blood-agar culture, but there was no growth on the other media. Before any treatment had been instituted, glucose-agar, bouillon, and anaërobic cultures were all sterile for four days. Four days after drainage of the bladder an agar culture showed staphylococcus, streptococcus, and Bacillus coli. A staphylococcus, gram-negative saprophytic organism was found on anaërobic culture. Bouillon culture showed streptococcus and staphylococcus and a gram-negative bacillus. At the time of the prostatectomy, glucose agar, blood agar, anaërobic cultures, and bouillon showed Bacillus coli and pneumococcus. Glucose agar, blood agar, bouillon, and anaërobic cultures of the urine four days after prostatectomy showed pneumococcus and Bacillus coli.

A glucose-agar culture of material taken from the wound four days after the prostatectomy showed large gram-negative saprophytic bacilli, probably saprophytes.

In spite of the fact that many organisms were present in these cultures, the patient showed no evidence of infection at any time and made a prompt recovery.

PROSTATECTOMY*

By John B. Deaver, M.D.
of Philadelphia

The selection of cases for prostatectomy is far more important than is the method of approach. The unavoidable complications of the operation, including pneumonia, pulmonary embolism, acute dilatation of the heart, and cerebral embolism, should exceed in number the common causes of death, of which the most frequent are uræmia, hemorrhage, sepsis, acute renal infections and apoplexy. The incidence of pulmonary congestions and infections will probably remain unchanged, although some benefit may be expected to follow careful regulation of the hygienic regimen and judicious selection of the anæsthetic. The decision for or against prostatectomy in cases in which the probabilities of prolonged comfort with catheter life are great, may depend upon the presence or absence of emphysema, bronchiectasis, chronic bronchitis or tuberculosis. Pulmonary complications of such gravity as the aforementioned are clear contra-indications to operation, provided the patient can find reasonable comfort in non-operative measures.

Obstructions of the lower urinary tract give rise to early destructive changes in the kidneys through alterations in the mechanics of urinary excretion. The renal changes, serious in themselves, give rise secondarily to cardiovascular and metabolic disorders, and the resultant invalidism renders the subjects of the associated pathology hazardous risks in major surgery. In addition to these chronic, and to a certain extent, irremediable changes in the cardiovascular and renal systems, the almost invariable presence of urinary infection adds another source of potential danger in the surgery of prostatic obstruction. At least 75 per cent. of the patients who present themselves for prostatectomy have an infected bladder, and in a considerable number the infection has invaded the upper urinary tract as well.

Infection in these cases is often beneficent in that its prolonged residence in the urinary tract has created a certain immunity on the part of the tissue, thus minimizing the danger of severe post-operative inflammation. In other instances the infection has already become widespread and has added its influence to back-pressure in renal destruction. In a third group of cases the inflammation, although localized to the lower urinary tract, has been so severe in its manifestation and has given rise to so much discomfort that the vitality of the patients is almost exhausted when they come to the surgeon. The average case presents not only a combination of the foregoing

*Read before the American Surgical Association, June 1, 1917.

processes which may be said to depend upon the urinary obstruction, but in addition his vital organs show the scars of the battle of a life almost spent. The degree of myocardial degeneration, arteriosclerosis and of chronic nephritis dependent upon ancient inflammations, and entirely independent of the obstruction at the vesical outlet, must be sought for and their probable influence in functional crippling ascertained.

The prostatic is therefore primarily a complex problem for functional study; a problem whose solution is the determination of the maximum reserve power of his vital organs. Ordinarily these patients have already drawn heavily upon their reserve function before operation is considered. Furthermore, it is safe to assume that there will be no further utilization of reserve power during the pre-operative time interval spent in the hospital. It is likewise fair to assume that the prostatic has reached the lowest ebb of vital function, that he will experience, barring, of course, the cases that are moribund when they come for hospital treatment. It is therefore the duty of the surgeon to ascertain by various tests and examinations the level of descent of vital activities representative of the lowest "ebb" of function, and so to treat the patient that the highest "flow" of function will be attained and maintained before attempting enucleation of the prostate. In no instance, however physically fit the individual may seem to be, is operation justifiable until these studies have been completed.

Before taking up the question of surgical treatment of the different classes into which these cases group themselves, we will consider briefly the means at our disposal for determining the vital reserve powers and the therapeutic measures useful to increase them.

The individual who passes a normal quantity of normal urine, that is, physically and chemically normal, is possessed in the majority of instances of kidneys that are surgically sound. Unfortunately, this is rarely seen in patients with prostatic enlargement. The chemical analysis of the urine of these patients, while important as an index of renal function, lacks the ease of determination and the accuracy of the phenolsulphonephthalein test. As an index to the capacity of the kidneys to excrete solids we have in this drug a means that is extremely simple in its application and one of the most accurate laboratory tests in general. A wealth of clinical experience confirms the original findings of Rowntree and Geraghty,[1] and the phthalein test is, at this time, one of the important means of determining the degree of renal function. We have learned to depend upon the urea nitrogen content of the blood as indicative of the renal activities. This test, while of great value and of the same significance as the phthalein test, is less applicable than the latter as a routine measure. The result of either test may be compared with that of the other, thus minimizing the dan-

[1] Rowntree and Geraghty: Jour. Pharm. and Exper. Therap., 1910, i, 579.

ger of misinterpretation. The indigo-carmine test is used frequently and always in connection with the two foregoing when there is any doubt.

The first estimation of renal function is made soon after the patient's admission to the hospital and, if possible, at the time of the first catheterization when the amount of residual urine is also determined. If the appearance time of the drug is delayed (over 15 minutes) and the total output is diminished (50 per cent. or less), preliminary treatment suitable to the case is instituted. This will depend primarily upon the amount of residual urine present and the degree and activity of an existing infection. Cases with large amounts of residual urine, especially those that have never been instrumented, are poor surgical risks when operated upon immediately after the initial instrumentation. With the relief of back-pressure on the kidneys incident to the sudden decrease of intravesical pressure a marked renal congestion occurs that, with the added irritation of an anæsthetic, may send there apparently favorable cases into uræmia.

Cystoscopic examinations are a source of great danger in impending uræmia. They should be performed only after it has been ascertained that a state of relative renal efficiency exists. In no instance should prostatectomy be attempted after a cystoscopic examination until the influence of this seemingly benign procedure on the kidneys has been determined.

It is our practice, as mentioned above, to contrast the results of the phthalein test with the urea nitrogen content of the blood. The elimination of the latter is a specific renal function, and abnormal retention of urea (over 0.35 per 1000 c.c. of blood, Tileston & Comfort) has the same significance as a low output of phthalein. These two tests have proved themselves in our experience of almost equal value. In cases with advanced secondary symptoms, including anæmia and loss of weight and strength, the determination of the alkaline reserve of the blood plasma (acidosis), as indicated by the hydrogen in concentration of the blood and the carbon dioxide content of the alveolar air, is made. Marked degrees of acidosis precede the onset of uræmia, but aside from this, convalescence after prostatectomy is invariably uncertain when marked retention of acid salts exists.

Having demonstrated a low state of renal function, it becomes necessary to ascertain its cause or causes. The relief of back-pressure on the kidneys following the institution of catheter treatment generally results in increased kidney function. An increased output of phthalein is noted, and this improvement progresses to a point where the percentage output of the drug becomes stationary. If this maximum of elimination is well beyond the low normal level, the subject is generally a good one for prostatectomy. If, on the other hand, the output of the drug increases under appropriate treatment to a cer-

tain extent but the improvement stops at a subnormal level and persistently remains there, further cause for the renal defect than back-pressure must be sought for.

Antecedent chronic nephritis, independent of the effect of low urinary obstruction, sometimes is an important consideration. This is determinable only by exclusion. Frequently the renal inefficiency is dependent upon the cardio-renal lesion with the cardiac factor predominating. The latter may be of valvular origin but is more often due to chronic myocardial degeneration. Cardiac decompensation, dependent upon weakening changes in the musculature of the heart, is a serious complication that offers little or no hope of complete restoration; with few exceptions, however, these patients may be improved to the extent that prostatectomy may be safely attempted. Prolonged medical treatment is necessary, and the best index of improvement is the gradual decompression of the kidneys as measured by the phthalein output.

High arterial tension becomes a complicating factor in the minority of cases. This generally improves coincidently with increased renal elimination, but in certain instances a persistent high blood pressure calls for specific treatment. Free catharsis suffices in the mild cases; drug therapy designed to lower the pressure is rarely permissible. In pre-uræmic states bloodletting with transfusion, hypodermoclysis or saline by the bowel will bring immediate results in the majority of instances. Diuretic drugs, including spartein, sulphate, caffein, and potassium citrate, are probably harmless and may be of some value.

In cases of acidosis sodium bicarbonate should be administered by mouth until the urine becomes alkaline in reaction. Severe degrees of the condition call for infusion of sodium bicarbonate solution. The administration of glucose solutions by proctoclysis is a valuable adjunct in profound states of acidosis.

It is evident from the foregoing brief account that we have lately acquired valuable means of determining the operability, the temporary inoperability and the permanent inoperability of vesical obstruction. The tests are of greatest value as indexes of the improvement expected to follow pre-operative treatment. Experience has taught us that prostatics fall into more or less clearly defined groups depending upon the local condition of the lower urinary tract and upon the degree of renal and cardiac defects. In addition we have learned that certain specific forms of treatment before operation are indicated to bring each group to the point of maximum resistance.

Group I may be made to include those cases of early prostatic hypertrophy that present few subjective signs, in which the bladder capacity is approximately normal with small amounts (less than 150 c.c.) of infected or non-infected residual urine, a normal phthalein output, and no serious organic defects in the heart or blood-vessels.

Cases of this kind may be operated upon when the patients have become acclimated to their hospital surroundings; when the various tests have been carried out and after a cystoscopic examination has been made without deleterious after effect.

Group II includes cases in a later stage of prostatism with or without marked secondary systemic symptoms. Patients in this class are subjectively ill. The prominent symptoms are frequency of urination, dysuria and hæmaturia. Examination shows the presence of large amounts of residual urine which may or may not be infected. The bladder walls are atonic and diminution in kidney function dependent almost entirely upon back-pressure is disclosed. Patients belonging to this group are often fair surgical risks at the outset and will become excellent risks with the institution of proper pre-operative treatment. The latter is designed primarily to relieve back pressure, to bring about renal decompression. The question now arises shall we attempt the relief of the kidneys by intermittent or permanent catheterization, or shall we drain the bladder suprapubically, thus dividing prostatectomy into a two-stage operation. It is our practice in dealing with the mild cases in which the amount of residual urine is small first to try intermittent catheterization with sufficient frequency to keep the bladder empty. If under this form of treatment the phthalein output rapidly increases, no further preliminary treatment designed to relieve back-pressure is considered necessary. The permanent catheter, which formerly held such a prominent place in our pre-operative treatment of prostatics, has been practically abandoned. Its use is reserved for cases of such severity that the simple operation of suprapubic cystostomy is contra-indicated. The presence of a catheter in the urethra is so often ill-borne in cases where an intense cystitis exists, and, in our cases, the frequency of epididymitis, complicating its employment has been such, that we have adopted suprapubic cystostomy in the majority of instances where previously an indwelling catheter was employed. There is, however, a definite group of cases in which the gradual diminution of back-pressure on the kidneys or improvement in the cardiac condition is necessary before the operation of cystostomy is permissible. In these cases the indwelling catheter has a definite field of usefulness.

Group III includes cases in which a small, contracted, severely ulcerated bladder gives rise to distressing symptoms. The existing infection has generally invaded the upper urinary tract and pyelitis, pyelonephritis or pyonephrosis are serious complicating factors. Hydro-ureter and hydronephrosis are concomitant associates in certain long-standing cases where the infection is confined to the bladder. The obstruction at the vesical neck in cases belonging to this group is frequently of the stricture variety and of inflammatory origin, or if the obstructive factor is an adenomatous mass, it is usually of the horse-

collar or ball-valve type. The bladder contains little or no residual urine. These patients bear instrumentation badly and epididymitis is a frequent complication. On account of hematuria, urinary distress and toxæmia, of both bacterial and renal origin, the vitality of the patients is at a low ebb when they first present themselves. This group offers the least chance of operative cure, and prostatectomy is not infrequently a complete failure even as regards symptomatic relief. Attempts should be made to improve the general condition along the lines already suggested, and in this effort sedatives and tonics play an important part. Despite the most careful treatment it often becomes necessary to drain the bladder at a time when under other circumstances prolonged pre-operative treatment would be advisable. The mortality in this group is high and the morbidity dependent upon operative complications is great; fortunately this group comprises the minority of cases. The differential diagnosis between this variety of vesical obstruction, vesical tuberculosis and carcinoma, of either prostatic or bladder origin, is oftentimes made with great difficulty.

There are many gradations between the clear-cut clinical pictures of the foregoing groups; each case is more or less a clinical entity and should be treated as such. The general application of the principles of pre-operative treatment outlined above will serve, however, to illustrate the plan of treatment to be employed in the individual case as it approaches one or the other of these groups.

I have already remarked the increasing frequency with which we are adopting the two-stage operation and have, in a general way, defined the indications for preliminary suprapubic cystostomy. The two-stage procedure is now employed in all cases where catheterization fails promptly and permanently to relieve the effects on the kidneys of back-pressure. This method is likewise employed in all cases, regardless of the ease or difficulty of improving kidney function by other means, where an active urinary infection exists. Finally, it is our method of choice in that considerable group of cases where doubt exists as regards the ability of the patient to withstand the one-stage operation of suprapubic prostatectomy. It has been our experience that the two-stage operation by the suprapubic route is the safest and surest way to relieve obstruction at the vesical outlet.

The patient is operated in the Trendelenburg position. The preliminary cystostomy may be done under infiltration anæsthesia, although I never use it. In the absence of definite contra-indications the use of ether by the drop method, gas-oxygen, and occasionally, for example, a patient with a very high blood-pressure, chloroform. Intraspinal anæsthesia is rarely used; we regard it a dangerous anæsthetic.

The prevesical region is exposed through a right rectus muscle splitting incision. The incision is placed over the lower, inner border of the muscle, care being taken to avoid the midline. It should be of

sufficient length to give ample exposure of the bladder. The two portions of the muscle are retracted laterally, and a small piece of gauze placed in the upper angle of the wound. The piece of gauze with the upper angle of the wound is retracted upward; this piece of gauze also serves the purpose of protecting the peritoneum against injury, at the same time putting the prevesical tissue on the stretch, thus rendering further dissection more certain. The prevesical tissue is cut through, not torn through or scraped away, by blunt dissection or with gauze. The veins in the prevesical tissue are avoided, if possible, and, if not, are cut and ligated. The bladder wall is now exposed and grasped or steadied with a pair of small tissue forceps, and cut through as near the summit as possible, when a pair of retractors is introduced into the bladder, and traction made laterally. The cavity of the bladder is now mopped dry with small pieces of gauze, palpated and inspected; stones are sought for and if found removed and careful inspection of the prostate made. A rubber drainage tube one-quarter to one-half inch in calibre with a lateral opening in the lower end is introduced into the bladder and carried down to provide perfect siphonage of the bladder cavity. The bladder wound is closed up to and close to the tube when it is anchored by an iodine catgut suture passed through either half of the rectus and bladder wall, and the suture tied down upon the rectus beneath the anterior sheath. The margins of the incised prevesical fatty tissues are brought together with interrupted iodine catgut sutures, a small piece of rubber dam is placed in the prevesical space and the wound of the soft parts closed. The tube is held in position by carrying a silkworm-gut suture through the skin and anterior sheath of the rectus muscle as well as through the side of the tube.

Before tying the latter suture, the siphonage should be tested by introducing a fluid through the drainage tube, and unless it is perfect the silkworm sutures must be removed, the tube must be either raised or placed at a deeper level. The anterior rectus sheath is closed with a running iodine catgut suture and the superficial wound closed with one or two through-and-through silkworm-gut sutures, including the anterior sheath. The wound is dressed and the patient returned to bed.

Preliminary drainage of the bladder is continued until the maximum physical efficiency of the patient is demonstrated by the various tests, already described, which is usually about two weeks. Enucleation is done under ether or gas-oxygen anæsthesia, occasionally chloroform in a patient with high blood-pressure; we rarely use spinal anæsthesia. The original ventral incision is reopened above and below the drainage tract to the extent necessary to permit free manipulation within the bladder. During the time of healing after the performance of the first stage of the operation the prevesical and perivesical tissues adjacent to the incision have become fibrosed and their contained lymphatics

obliterated. The healthy tissues are in this manner walled off from the operative field of the second stage of the operation. Care should be taken not to break through this protective barrier. The opening into the bladder is enlarged if necessary. In cases with marked intravesical projection the enucleation is begun by tearing through or, in some instances, by cutting through the thin mucous membrane overlying the most prominent lobe. In other instances the dissection is begun in the urethra after the method of Squier, the line of cleavage between the adenomatous masses and their sheath being sought for through the roof of the prostatic urethra anteriorly. In the majority of instances in which the hypertrophic enlargement of the prostate projects itself into the bladder, the sphincter muscle has been pushed aside and is in little or no danger of injury during an enucleation begun from the vesical aspect after the method of Freyer. Where the most prominent nodules present themselves in the urethra, the method of Squier has the advantage that the sphincter is in less danger of injury than with the Freyer method.

Hemorrhage immediately following prostatectomy is usually due to incomplete removal of the encapsulated mass, for the same reason that retained secundines cause uterine bleeding. In both instances natural hæmostasis is prevented because of the impossibility of firm contraction of the muscles surrounding the cavities. In the event of profuse hemorrhage immediately following the extraction of the gland that is not easily controlled by pressure temporarily applied, it is my practice to enlarge the wound sufficiently to give free access to the prostatic bed. A pursestring or overrunning suture of plain catgut is then placed in the mucous membrane forming the margins of the cavity which is then packed firmly with a single strip of gauze, the free end of which projects through the parietal incision through the bladder wall alongside the drainage tube. The pursestring or overrunning suture is then drawn taut and is tied. Uncontrollable hemorrhage has been unknown in our work since the adoption of this simple procedure.

The different technical steps in the operation will vary with the several types of obstruction. In those cases dependent upon sclerotic changes in the region of the vesical neck and in which total enucleation of the prostate is indicated, we prefer the perineal avenue of approach. When the indications exist for the removal of an obstructing bar, or where sclerosis of the bladder orifice indicates the necessity of excision of a wedge from one or more points in its circumference, we much prefer to do the work through a suprapubic opening under the guidance of the eye, and with a rongeur forceps or a pair of Sir Henry Thompson's prostatic forceps.

Suprapubic prostatectomy is as safe a procedure in expert hands as is the infrapubic operation. In the hands of those of little experience

the suprapubic is far safer than the infrapubic operation. Fistula, incontinence of urine and failure to relieve the obstruction at the vesical outlet are frequent complications of the infrapubic operation that should be practically unknown following the suprapubic operation.

It is my practice in a large percentage of cases to make a circular incision through the mucous membrane and the overlying prostatic sheath around the vesical orifice of the urethra and carry my enucleation through this gutter which, when completed, does not make any irregularities of the mucous membrane, such as have been known to offer subsequent obstruction and require removal in order to restore function.

Rigid adherence to the modern principles of pre-operative treatment is of greater importance, however, so far, at least, as immediate mortality is concerned, than either the method of approach or the technic of its execution.

SOME FURTHER DATA ON ARTIFICIAL IMPACTION OF THE HIP*

By Frederic J. Cotton, M.D.
of Boston, Mass.

I promised a bit more than I can fulfil, namely an account of results (including my more recent cases) of artificial impaction in loose hip fractures within the joint, and I must ask your forbearance if I only do the best I can, and report those cases on which I have data on hand, and such data as I have on hand.

First, may I say that I am more than ever convinced that the average result of our hip fractures has been entirely misunderstood and, therefore, misstated. I believe that the cases treated in our general hospitals here (and there is no reason to believe us peculiarly accursed) will show well under two-thirds, probably under one-half, of functional good results,—anything anywhere near restoration of walking power in hip fractures in all adults (to say nothing of the aged) whether intra- or extracapsular in type.

The failure to accomplish results in the extracapsular fractures of the neck has been one purely of failure to understand the situation and to meet it by adequate care of reduction and in after-treatment.

So far as I have been able to learn from my own cases and from many others, seen or read of as reported by other men, I can only conclude that non-union in these cases is a negligible factor,—that the question is only that of fixation carried out in such a way as shall insure reasonably accurate reposition of the fragments and that avoidance of adductor contracture which is so important a part of the after-treatment not only of hip fracture, but all lesions of the hip joint. Apparently adduction contracture is an important, if not the chief factor in the disability of most hip injuries that do badly.

Whether this feature is best to be combated by the method of Phillips, Maxwell and Ruth,—the method of traction in abduction combined with lateral traction,—or by the method for which Whitman has made large and repeated claims—fixation in abduction after manipulation: or by Moore's scheme of abduction in flexion in the so-called "frog-spica": which of these is the best in this particular class of cases I do not feel that I am qualified to say.

I have used the first method once with success.

I have used the second and third repeatedly.

Whitman's method, *in this class of cases,* has given poor reduction, with overlapping of fragments—in two cases. In the others of this class it has worked out well.

Moore's method has a very definite advantage in that one may "sit up" these patients without mechanical damage—*immediately.*

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* Read before the American Surgical Association, June 2, 1917.

It has the *disadvantage* of involving flexion of the knees, and in all my cases, including artificially impacted fractures and open operations as well as simple extracapsular fractures, there has been a good deal of trouble after use of this spica in "limbering-up" the knees of the stiff old people who in practice are the ones who break their hips.

All these cases have eventually done very well, and I think that if we are to adopt abduction as a schematic treatment, for *extracapsular* fractures, abduction should be abduction in flexion; but I am a bit uneasy about recommending this for big hospitals, because the method, good as it is, requires an efficiency in after-care that can not always be secured.

As to the intracapsular cases the situation is different.

Among these some come to us already impacted by the fall that broke the bone, and in fair position.

In these cases there are but two things to do—first, guard against adductor spasm and eventual contracture of the powerful adductors; second, minimize eversion. This does not necessarily mean forcible correction (loosening up of the impaction) but may be carried out as I have done it repeatedly, by gradual correction with sand-bags to the best position attainable in the given case, without spoiling the impaction.

Whatever the treatment a certain number of these cases are going to lose out!

There is always marked absorption of the bone of the femoral neck in these cases.

This does not occur in the extracapsular cases and varies very greatly in amount in different intracapsular cases.

We have been familiar with this in the cases primarily unimpacted in which the absorption is very rapid, but we have not understood that the process is universally present nor have we understood its importance.

In every case of intracapsular fracture, whether impacted or not, and even if it is only a crack, careful X-rays at intervals show an absorption with porosis of the bone and with shortening of the neck and often with a bending of the neck into coxa vara.

Even if repair is fully satisfactory this occurs, along with the repair, if the bone-forming power is poor the softened bone fails to hold the impaction and it simply falls apart. I shall presently show a series of plates exemplifying this and I believe it to be common. Again and again I have looked up old hospital cases down in the records as impacted and with X-rays that I accepted as showing impaction, in which the hip proved to be loose when I found them a year or two later. Most of these were the others fellows' cases often sent out in a month on crutches, but I have had this thing happen to two cases with apparently firm impaction while they were in bed under the best care I knew how to give them. I believe the occurrence is not unusual. It is an argument for long protection and late weight bearing in all these cases.

I'm perfectly ready to have weight on the extracapsular cases at two months but have made it a rule to have the intracapsular cases whether

impacted by accident or by me kept in plaster three months, no weight for four months, and full weight only at six months.

And even at this I know I am going to have failures.

What we need is to know what happens to our cases. So far from their all doing well, I think the intracapsular cases in particular do badly under ordinary treatment in a majority of the cases, and shall continue in this belief till somebody comes across with end-results figures to match the assurance that "they all do well under my system."

They do not under any system.

Now as to the impaction proposition.

It concerns itself only with a small class of broken hips, namely, with the intracapsular or subcapital fractures, the fractures of the neck proper—whatever you choose to call them—in which there is no impaction present or in which the deformity, especially the eversion deformity, is extreme.

The operation puts these cases into the much more fortunate class of firmly impacted fractures in improved, often in perfect, position.

They are then to be treated exactly like the cases of accidental impaction, and are of no better prognosis save that the average position is much better and the impaction perhaps firmer.

Many of my friends say that artificial impaction is impossible and that I do not do it. I can only say that some of you and a good many other competent surgeons have seen the thing done—very skeptical some of them were, too, and they have without exception been convinced of the fact that it can be done—irrespective of course of the natural difference of opinion as to whether it should be done.

Now as to the cases, I have had but eleven cases since the last report.

Case I.—A case in a woman of sixty, operated on for Bapst Blake seven weeks after the injury, operated on, I confess, partly to demonstrate the method at the time I showed some end-results before the Clinical Congress of Surgeons here in October, 1915, without great hopes of success so long after the injury. The impaction seemed to be successful, the foot no longer flopped outward, and the trochanter moved in the long arc, not on its own centre. This was verified by Murphy, Peck and others of our fellows. Position was maintained well until discharge. After that she had only the care possible in a well-managed pauper institution. The clinical result is nothing to boast about. The woman is old, broken, and feeble. Whether the result here is a bony or a close fibrous union is perhaps debatable. In either case I submit that it is much better than one gets in untreated unimpacted cases.

I do not feel, however, that my operation should be advised with any optimism in cases after three or four weeks—perhaps not after two weeks. Smoothing off and cicatrization of the broken ends probably occurs early, and any impaction produced late is not the desirable mutual impaction of clean bone surfaces of full reparative power.

Case II.—A woman of forty-two, operated at the New England Hospital for Women and Children. This woman had advanced tabes

and various tertiary lesions. She fell, and broke her hip. I impacted it, and under the usual routine obtained a *bony* union, with little deformity or shortening. At the end she had very nearly the function limited by her old locomotor trouble.

CASE III.—Mrs. M., aged fifty-six, operated on for Dr. Elizabeth Gray at the New England Hospital for Women and Children. A fresh case of entirely unimpacted hip fracture. I have no late X-rays of this case but I have seen her within the week. She can walk without support though she is apt to use one crutch or a cane if long on her feet. The shortening is just under an inch. Her disability is largely one of defective muscle power. The fracture is immobile and corresponds to all clinical tests of a bony union.

CASE IV.—Mrs. G., aged sixty-three, operated on at the Cambridge Hospital, April 13, 1916, for Dr. August. A type case of loose fracture operated on as usual. She is now walking after a year, fairly well, with one crutch or a cane. The hip is solid and painless. The defect, such as it is, is one of muscle power.

CASE V.—A. B., aged forty-eight, operated at the Cambridge Hospital, July 14, 1916, for Dr. Dudley. Usual case of unimpacted fracture, treated like the others. Impaction and position maintained for four months. Union apparently solid then. I have been unable to locate her to see the end result.

CASE VI.—Mrs. N. C., aged sixty-two, operated for Dr. Horace Stevens at the Cambridge Hospital, June 21, 1916. A type case, operated on in the usual way. Seen May 28th, she had obviously firm bony union—a shortening of less than half an inch, over half the normal motion, and can walk. She is still using a cane.

What disability remains in this case is largely muscular.

The hip is solid.

CASE VII.—Mrs. R., operated on at the Brigham, on request of Dr. Cushing, January 5, 1916. The usual findings and the usual procedure and after-treatment.

This case is interesting because we can trace the bridging across by bone of part of the defect that long continued fibrous. In this case the woman showed, at fifteen months, excellent function and bony union.

CASE VIII.—M., operated for Dr. Blake. Reduction and impaction went well. End result not known. Went "O. P. I." to the city hospital on Long Island.

CASE IX.—Operated for Dr. Blake. Everything all right up to discharge. Went to the city hospital on Long Island. End result not ascertained.

CASE X.—S., old broken man of sixty odd. Probably not a fit case for operation. Reduction and impaction went well, but after removal of the spica at three months the limb gave way; there was not even an attempt at union.

CASE XI.—Mrs. McG., aged sixty-five, looking at least ten years older. Operated for Dr. Harvey Cushing. Type case, type procedure, December 6, 1916. Reduction excellent, but absorption unusually great. Up to February 21st the cast was kept on—two and a

half months. The skiagraph a week later showed the impaction still obvious. After another week the coxa vara had increased, but the impaction seemed still serviceable. April 24th, at four and a half months, the impaction had entirely given way, despite all care. This case was a failure. Whether harder impaction or better after-care would have done better, I do not know.

CASE XII.—A woman of fifty-eight. Type case. Operated on December 23, 1916, with the type of procedure as usual. Reduction was satisfactory, and everything looked favorable enough until she died after twenty-one days of myocarditis.

CASE XIII.—Mrs. McD., aged sixty-nine, type case. Usual operation December 23, 1916. This case has gone on well, though, perhaps because she was extremely fat about the hips, I did not get as good a position as usual. She is still at the Newton Hospital, and is beginning to walk about fairly well with a crutch. Union has not given way, and I expect her to regain pretty near full function.

Now this series chances to be almost entirely of cases operated on for others at outlying hospitals, and in most instances under circumstances precluding the after-care as to massage and passive motion that means so much in the regaining of function.

As to functional results this series leaves a good deal to be desired.

As to anatomic results, it shows that artificial impaction may give way months afterward, just as accidental impaction does in individuals whose bony, as well as general, nutrition is low.

Both the cases in which this happened were very old and feeble. But I submit that this series does support my contention that the unimpacted cases can be reduced and can be impacted so as to give them at least the chance of good results normally due in case impaction is originally present.

To Contributors and Subscribers:

All contributions for Publication, Books for Review, and Exchanges should be sent to the Editorial Office, 145 Gates Ave., Brooklyn, N. Y.

Remittances for Subscriptions and Advertising and all business communications should be addressed to the

ANNALS *of* SURGERY
227-231 S. 6th Street
Philadelphia, Penna.